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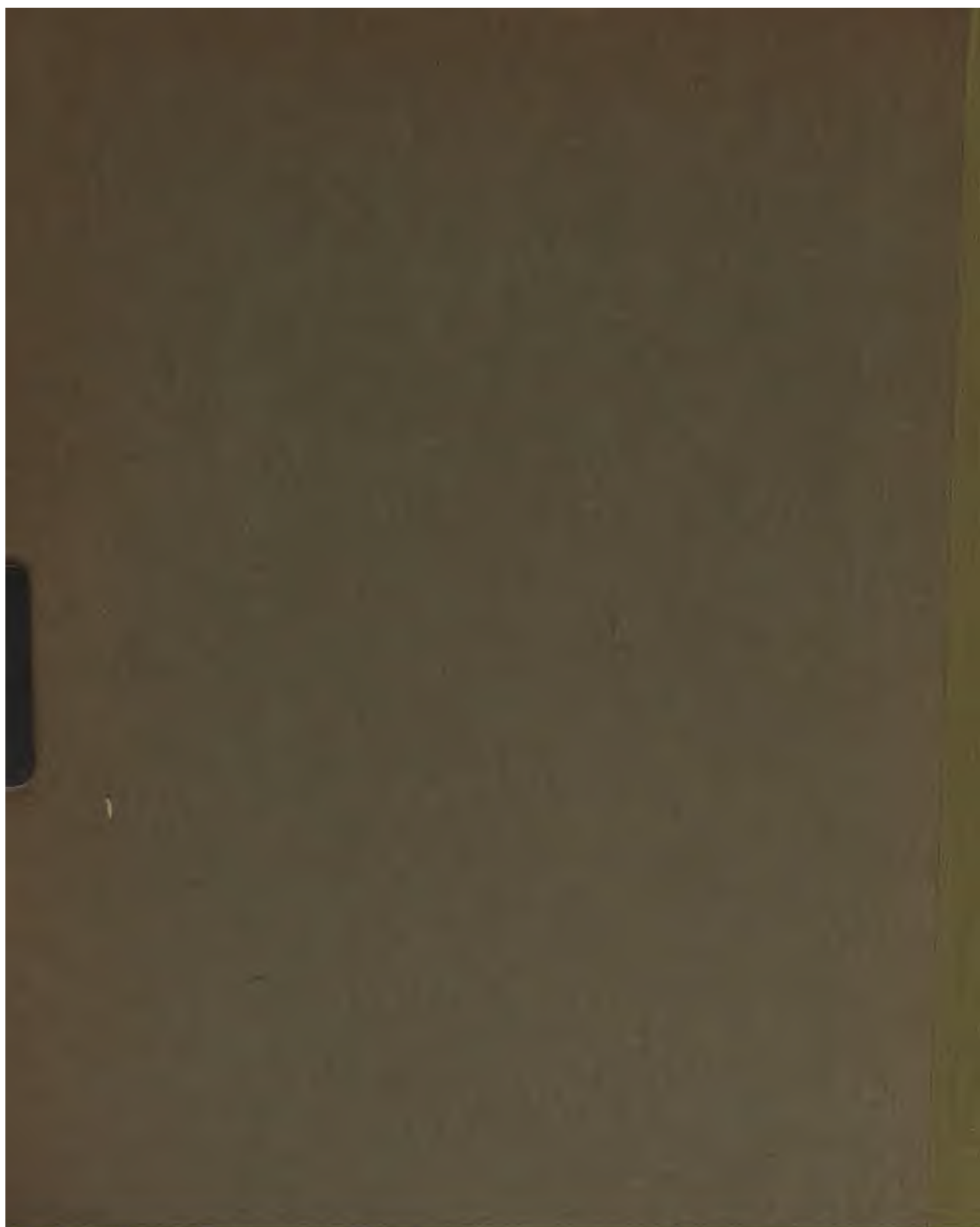
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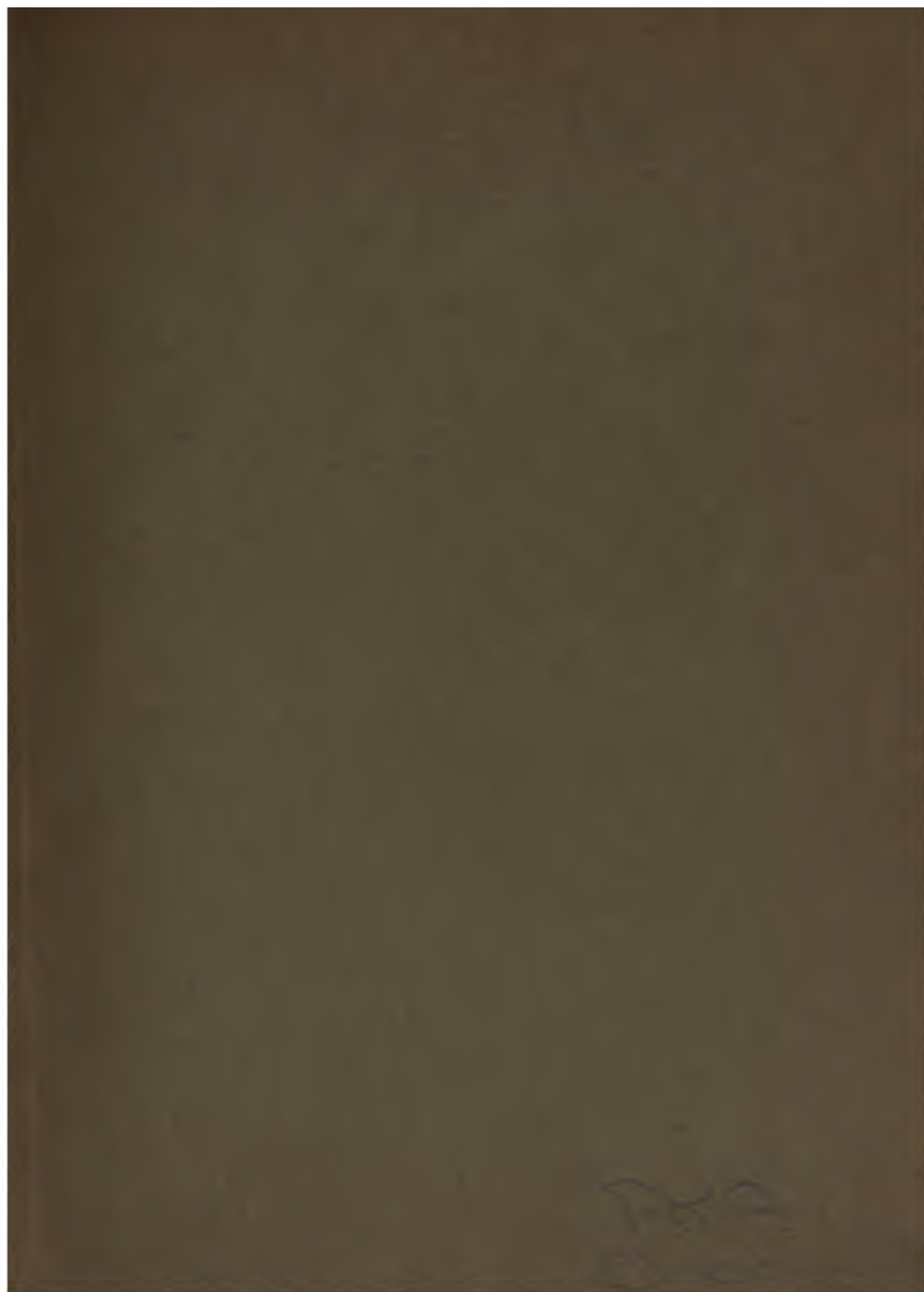
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CHEMICAL NEWS

AND

*Dr. John S. Billings,
U. S. Army.*

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

AUTHORIZED AMERICAN REPRINT, VOLUME IV.—JANUARY, TO JULY, 1869.

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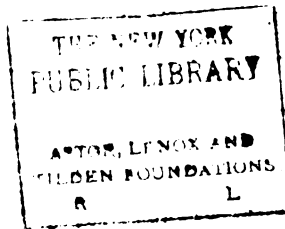
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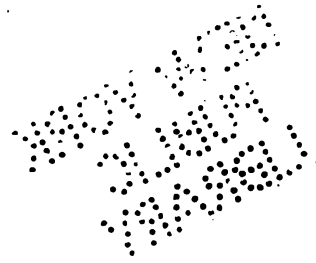


VOLUME IV., AMERICAN REPRINT,

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PREFACE.

CERTAIN features recently added by its English Editor and proprietor to the LONDON CHEMICAL NEWS, which will doubtless be continued and improved, give assurance that it will henceforth have place, as in the past, in the very front rank of the scientific journals of the world. These appear to a certain extent in the present volume. Particular attention is directed to the largely increased attention lately given to CHEMICAL NOTICES FROM FOREIGN SOURCES, and to a new department—NOTES ON LECTURE EXPERIMENTS—which will hereafter be found by itself, in the Reprint.

On their part, the American publishers herewith submit their fourth semi-annual volume to all interested in science, with the confident guaranty that the REPRINT of the English Edition, and the AMERICAN SUPPLEMENT, with its original notices of current scientific progress in this country, and the AMERICAN DRUGGISTS' PRICE CURRENT, will continue to fill the high places heretofore occupied by each of them, in the esteem of all who consult their pages.

W. A. TOWNSEND & ADAMS.

NEW YORK, JUNE 1, 1869.

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Volume IV. January, 1869.

CHEMICAL LABORATORIES OR WORKSHOPS.

LIEBIG used to say that when he went to Giessen, he was put into a place like a gardener's tool-house, and in that he was expected to make discoveries and prepare his lecture experiments. His influence was sufficient to procure a pleasant house, with a laboratory below, and with several apartments; but his fame grew until that laboratory became small and trifling, and a mere place for rough work attached to that large and famous one which, like himself, attracted so many of all countries, and which especially brought him into connection with England and Englishmen. Now the fine new laboratory is small, whilst not many miles away one has arisen so far unlike a mere tool-house that the Grand Duke himself might rejoice in the libraries, sitting-rooms, halls, passages, and general aspect of the place, if he could not enjoy working in the bright and commodious student's apartments.

We all recognise that the world is moving fast, but whilst we do so generally some movements are taking place with such rapidity that we cannot observe until the work done has surpassed our hopes and sometimes our understanding. The God who made creation is explaining his works, and man who is made in his image is imitating the work of creation. We have lived without the knowledge of creation, and so far also of the Creator; but as this power becomes revealed to us in science, it begins both to delight and to awe us in regions which before seemed dark and empty. Scenery on the surface of the earth has long pleased us. As we go down we find new strata of delight. The influence of science on man's mind will increase, and we can only suppose that it will move forward as steadily and constantly as the earth itself. Already some men are so astonished at the magnitude of some of the parts that they believe that nothing else can be in existence, and so they have bowed down. They do right to worship the highest that they know, as a dog worships his master, even if he be but a beggar and a thief.

We may like or dislike the movement, although both feelings will be spent in vain. The knowledge of natural laws will enter into our minds so thoroughly, that private, social, and political life will be equally penetrated; but every one likely to read this knows it perfectly well, and why should it be repeated? Are even journals of science to tell us old tales instead of discoveries, and stultify their own prophecies regarding the progress of truth by telling us only the popular notions of the time? We would answer to the first part "Yes; we fear they must do so." Although science will have much to do so in ruling the world, it is by no means certain that we, as individuals or as a nation, shall have its full benefit. In all great revolutions there are the conquerors and the conquered; the balloon moves calmly even in a storm. We had last year a great congress to discuss technical education. It

was a rough attempt to grasp at science for mercantile purposes, and the movement has calmed down. The result is no trifle, but it is not all that was anticipated. Mechanics have shown themselves most prominent, and neither the Government nor private men have done for any branch of science what Whitworth has done for mechanics. It is well to do one work at a time. He seldom does good who expends his efforts on the human race generally. Let us take a smaller range and try to do something in relation to the science and the scientific men that interest us most.

When Liebig was emerging from his garden tool-house there were no laboratories for students in London, and none in Oxford or Cambridge, although there were eminent chemists. Before the new Giessen laboratory was made, Graham had made the Andersonian Institution in Glasgow more famous than it had ever been; and produced a school, perhaps the earliest issue of a number of trained chemists from one place at least in Britain. As the flow of thought was towards organic chemistry, and necessarily so, the new laboratory at Giessen took the lead, although the then new London colleges had both laboratories for the professors, and the Birkbeck rose to assist them.

When Liebig got his new work-rooms, he was not slow to seek the same advantage for others, and he laboured hard to induce the Prussian Government to provide accommodation for Rosé; but that Government would not listen, and England was more easily persuaded. We not only took his plan for a laboratory, but we took the teacher he sent, and if not to our own fame at least to our own advantage. Hofmann has made his most famous discoveries among us. The School of Mines had a very limited idea of its duties as regards chemistry when it gave only a corner for its exercise, and Manchester took the next most promising step amongst us by building the laboratory of Owen's College. But Germany still kept ahead, and Bunsen and Wöhler at Heidelberg and Göttingen obtained buildings beautiful and commodious, and quite according to their own mind. Since then Oxford and Cambridge have come into the field.

Germany reviewed this advance, was dissatisfied with the constant slight increase, and there rose in her the spirit that had built her great and numerous universities, and filled her towns and even villages with public buildings. There every officer and office has such abundance of house room that we wonder much why with our wealth we should be forever cramped.

Prussia began with two great buildings in Berlin and Bonn about three years ago, whilst Leipzig began later, but is finishing hers at the same time.

How shall we describe that of Berlin? Let us take Jermyn Street School of Mines, and multiply it by from two to three, and probably the total space occupied by the new laboratory will be found. And yet the laboratory in Jermyn Street is only a small room in a corner. The idea is destroyed that a cellar or any hole may do

or a laboratory. This is a mansion of a noble kind—a palace. The idea is destroyed that the more menial the work which a student performs the greater his success. Every help is given, and he is left to do that only which cannot be done by less educated persons. It is said in Germany that Hofmann has injured the student by offering him too many facilities in his work, and that when he goes to manufactories in the country he is frequently in difficulties. True, when the student leaves the university with its fine libraries and its learned professors, he is thrown on his own resources, and unless he is soundly taught and of sound mind he will not keep his position; but for a chemist to make his own apparatus was never possible, and he is every day becoming more dependent on the mechanical art. No chemist makes his own balance, although he ought to understand it, and much less should he lose time by the detested process of making sulphuretted hydrogen if he can get it done for him. If it is merely to learn, let him learn; but one may as well ask him to dig his own coals out of the pit or at least bring them from the cellar. There was a time when chemistry was begun by rubbing and hammering in a heavy mortar, and this continued until the next unfortunate apprentice came; we have heard this experience from one of the most eminent. As we rise so does the stage of menial work rise, and we begin where our forefathers ended. We may be glad as well as the student when he can turn on his sulphuretted hydrogen by a tap, and when he can even do the same with oxygen and hydrogen, and when he is saved the trouble of an air pump and can turn on a vacuum like steam. Chemists have certainly lived in unwholesome atmospheres. We are glad to see the rooms enlarged, and the passages wide and lofty, so that they may serve as places to walk in if any accident should for a while render the air impure, and we can be no less glad to see the covered spaces with open sides which are beautifully fitted for work that cannot well be done in a fully closed room. It is interesting to see the room for spectrum analysis making a new feature in a laboratory; but one is tempted to think that even the great new buildings make this department too small. We may live to see that little room much expanded; we may learn also to look on our present mode of filtering as so slow as to be quite unendurable and the use of pressure quite indispensable. Hofmann's laboratory is a fine public ornament to a street; the buildings touch it on both sides. Kekulé's stands alone like a separate college, handsome where most things are beautiful. One wonders if those great halls and magnificent passages and stairs will ever see such discoveries as the little holes out of which the directors have got their first fame; but on second thoughts, it appears a poor remnant of an alchemistic prejudice which condemns a chemist to a building less beautiful than those which have been given to literary men in libraries and universities, on which the skill of architects has been lavishly spent. We must remember that although these buildings appear grand to us, there are young men entering them this very quarter to whom they will soon appear as the veriest commonplace, and these very young men will begin on the 1st of November to stand on the shoulders of all their predecessors. They will not all fall, and when they seek for advance it will be with very lofty heads, with a long vision and with a fine step rendered elastic by numerous mechanical aids.

We remember organic analyses done by charcoal furnaces in an unventilated room, which soon became so poisoned that the operator fell senseless to the ground

and was only slowly restored. It is pleasant to see the preparations everywhere made for working on clean benches, where not only no dust of charcoal is found, but even the gas combustion products are carefully removed. The laboratory at Leipzig, under Kolbe, has not quite the majestic appearance of those in Berlin and Bonn; but comparisons ought not to be made of this kind, and when we look at essentials and comfort, it is by no means behind, and even accommodates more students, viz., 100 as workers. Happy must they be in working, one would think, who remembers the weary time spent over filters before the present quick filter paper was known, whilst they have Bunsen's air pressure method driving their work on with a speed which will enable these youngsters to do in a day that which we in our student times, with scarcely pervious paper, could with difficulty have done in a week.

This is written from the outer point of view only; if we seek to examine the newer mode of making lecture experiments, we should be led into long letters and contrasts, so they shall be left with this remark that the problem seems gradually solving; How shall we find time to learn so much when knowledge increases so fast? The laws of nature which long thought only could make familiar to us become simplified by being put into operation before our eyes, and the chemist learns more rapidly the complicated system of to-day than he did the few facts and principles of the previous century.

The laboratories of Berlin, Leipzig, and Bonn begin in a few days.

We are building one,—namely, in Glasgow; it is attached to the new university. We have heard little of it. It is to be hoped that it is at least twice as large as any reasonable person could wish for present use, as, if otherwise, it will soon become offensive and another will be wanted. It is to be hoped that it will be so large that every student will not be a nuisance to his neighbour whilst his own freedom is diminished,—that he will be able to work without restraint, and less incommoded than a prisoner in his cell.

We are told of another—and that a fine one—building at Kensington, and it is to be hoped that public rumour is not correct, but that it is built under the care of an eminent chemist, and that it will be in all things worthy to stand comparison with, if not to surpass, those that have risen in Prussia.

We hear also of a desire to build a new one in Manchester, but it is said that it cannot afford the money. Is it less wealthy than the town of Leipzig, which pays for the new institution there, or is it less dependent on manufactures?

We do not venture at present on a history of laboratories in England; perhaps even our slight allusions may be wanting in chronological exactness; we mean only to bring to mind the comparative slow increasing of the importance of chemistry in the eyes of public bodies. There have been long a few small laboratories in and out of London for volunteers. It would be interesting to receive communications concerning them, speaking of a time before the rise of the London University.

ON THE ANALYSIS OF A GREEN FIBROUS MINERAL FROM CATHKIN.*

BY J. WALLACE YOUNG.

THE mineral of which I now give the analysis seems to have been derived from the decomposition or altera-

* Transactions of the Geological Society, Glasgow.

tion of hornblende. It is frequently found in the trappean districts around Glasgow, generally mixed up with more or less carbonate of lime.*

Colour, blackish green; structure, fibrous; of about the hardness of talc. The powdered mineral feels greasy when rubbed between the fingers. Gives off water when heated. B.B. becomes first whitish, and then fuses on the edges to a black glass. Easily decomposed by hydrochloric acid. The following is its composition, No. 1 is the whole mineral, and No. 2 after deducting the carbonate of lime.

Dried at 100° C.	
	I. II.
Silicic Acid.....	31'95 33'38
Alumina.....	15'40 16'10
Ferrous Oxide.....	21'10 22'04
Magnesia.....	20'95 21'90
Water (by difference).....	6'30 6'58
Carbonate of Lime.....	4'30 —
	100'00 100'00

NOTES ON LEMON-JUICE AND ITS DECOMPOSITION.*

BY W. W. STODDART, F.G.S.

PEREIRA gives an analysis of lemon-juice by Proust, showing that it contained 1'77 per cent of citric acid, or about 10 grains per ounce. The specific gravity is not mentioned. It is surprising that the statement should have been introduced into the last edition of that work.

In our excellent "British Pharmacopœia," freshly pressed lemon-juice is said to have an average specific gravity of 1'039, and an average quantity of 32'5 grains of citric acid per ounce. These two do not agree; the specific gravity is too great for the acid.

In Muspratt's "Dictionary," juice containing 7 per cent or 31'5 grains per ounce, is termed very superior.

In Mr. Watts's splendid work, 4'7 per cent, or 20½ grains per ounce, is quoted as the amount.

Muspratt says that lemons at an earlier part of the season are more acid, and as the season advances the water is a percentage or two higher.

All these statements are so greatly at variance with the results I have found, that I am induced to bring the subject before the Conference.

The Board of Trade have fixed very liberally for the vendors the specific gravity of 1'030 as the standard, and 30 grains per ounce as the least quantity of acid.

On February 25th of this year I bought a lot of lemons from six different shops, and after mixing them I pressed eight, which gave 7 ounces of juice, having a specific gravity of from 1'040 to 1'046, and yielding 40 to 46 grains per ounce, or 9'6 per cent of citric acid.

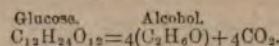
The specific gravity was taken by one of Griffin's hydrometers, as ordered by the Board.

The remainder of the lemons were put aside till the end of May, and again examined. The result showed that as the lemons were kept, and the summer advanced, the quantity of acid decreased (at first slowly, but at length very rapidly), but the specific gravity only suffered comparatively slight diminution; the quantity of the juice also remained the same, for eight lemons yielded 7 ounces in May, as in February.

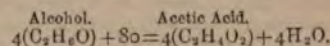
On examining the remaining fruit in July the curious fact was ascertained, that although the specific gravity

was 1'027, yet there was not a particle of citric acid. Analysis showed that it had all split up into glucose and carbonic acid.

Since this, the nitrogenous matter in the juice has again set the whole into fermentation. The glucose has produced alcohol, and the alcohol acetic acid, thus:—

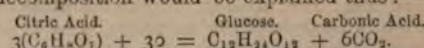


Then, after passing through the intermediate stage of aldehyd,



On examining a vessel containing a large quantity of lemon-juice, the peculiar earthy smell of carbonic acid is distinctly perceptible. For a clearer proof, a quantity of juice was put into a bottle which was connected by a glass tube with lime water, beneath which the glass tube dipped; all was hermetically sealed and laid aside, when the deposition of carbonate of calcium became sufficiently evident.

The decomposition would be explained thus:—



This change is of course one example among many of the chemical transformations which take place in the maturation of fruits, and a striking one it is.

Freshly expressed lemon-juice is a thin, milky, slightly yellowish liquid, having a specific gravity from 1'040 to 1'045, and containing from 39 to 46 grains of citric acid per ounce. Should either of these be less, the lemons must have been kept too long or gathered too late in the season.

Liquor potassæ turns the juice a peculiar dark colour, well known to those accustomed to diabetic examinations.

When freshly pressed the smell is aromatic, but when kept for a few days acquires the mouldy flavour which the commercial juice usually possesses. Trommer's and Fehling's tests give a decided indication of glucose.

With polarised light the ray is turned to the right. Acetate of lead gives a muddy white precipitate (gummate of lead).

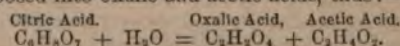
Chloride of barium, nitrate or acetate of potassium, or chloride of calcium should give no precipitate, indicating the absence of sulphuric, tartaric, or oxalic acids. The aroma of the pure juice is very peculiar, and differs as much from any artificial compound as rose-water distilled from the petals does from that made with otto.

The juice from limes is not so acid as that from lemons.

Through the kindness of a friend I obtained a dozen limes from Glasgow; from these I obtained a dozen ounces of juice. This was very much more aromatic and more delicate in its flavour than lemon-juice. Its specific gravity was 1'037, and contained 32'22 grains per ounce. It was, therefore, not so strong as lemon-juice.

Messrs. Southall, of Birmingham, furnished a sample as coming from the Olveston plantation in Montserrat, which had a deep yellowish brown colour; this, I presume, was given artificially, as that pressed by myself from the fruit was nearly colourless.

A singular fact was communicated to me by D. Davis, Esq., Medical Inspector for Bristol, which was (at any rate to me) quite new. Of course, all chemists are aware that when citric acid is fused with potassa it is decomposed into oxalic and acetic acids, thus:—



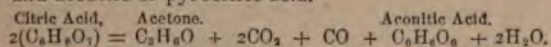
But when liquor potassæ is mixed with common lemon-

* Read at the Norwich Meeting of the British Pharmaceutical Conference.

juice in the cold, oxalic acid may be detected in a few days.

When lemon-juice is carefully evaporated it yields a rich brown extract, which is very peculiar both in smell, taste, and appearance, so much so that any one accustomed to make these experiments can in one moment tell whether or not it is a genuine juice.

An ounce of lemon-juice will average 27 grains of dry extract per ounce. After a certain point the extract becomes carbonised, having a rich brown colour and pleasant smell. This is owing to its partial decomposition into acetone, carbon, carbonic acid, carbonic oxide, and aconitic or pyrocitric acid.



It seems quite impossible to evaporate the juice to dryness without decomposition.

During the first six months of the present year a great number of samples of commercial juice were examined; some were plainly artificial, a few contained sulphuric acid, but most of them were merely diluted with water. The greater number of those obtained from the retail shops were artificial and in no single instance stronger than twenty-four grains per ounce.

The juice keeps its strength better separated from the fruit than in it. A good sample may be kept for years without sensible diminution of its acid, especially if fortified with spirit.

The cell-structure of the fruit seems to be the chief source of the fermentative matter, especially that part of the mesocarp that forms what is commonly called the white of the rind.

The ingredient in the juice, which is the therapeutic agent, seems to be a matter of dispute among medical men. Those who advocate Dr. Garrod's views—that it resides in the potash—must have a homœopathic idea of its value, and plenty of faith.

The analysis of many specimens of ash show only 3-10th grain of potash per ounce. Others, with Dr. Tanner, and I think with more reason, rely on the citric acid as the chief means for curing scurvy.

The molecules of citric acid are very remarkable for their tendency to change, especially when sugar or gum is present. As remarked before with regard to lemon-juice, so a solution of crystallised citric acid cannot be evaporated to dryness without decomposition, even with a very gentle heat.

Like all seaport towns, a great many cases of scurvy are present in Bristol, and I have the authority of several of our leading physicians for saying that they find the crystallised citric acid as efficacious as lemon-juice (especially with fresh meat and vegetables) in curing that disease.

But as this question is more in the sphere of the physician than the pharmacist, it had better be left in their hands for solution.

Mr. H. S. EVANS knew two firms in Liverpool who imported lemon-juice direct from Messina, and the inspectors would not pass it unless it contained 7 per cent of citric acid and 5 per cent of alcohol. He had a good deal of experience in the examination of such imported juice, and had always found from 7.5 to 9 per cent of citric acid and 4 to 5 per cent of alcohol. But there was no doubt that great adulteration was practised, and the Act had done good by putting a check upon this. With regard to the case in which citric acid was said to have been used for fortifying weak lemon-juice, he (Mr. Evans) was disposed to query whether a scarcity of

lemon-juice might not only justify such a procedure, but render it necessary.

The PRESIDENT thought that lemon-juice freshly squeezed was the only sort that should be used in pharmacy.

Mr. DEANE said that he laid in a stock of lemons when plentiful in spring, squeezed the juice, heated it to 180° F., and bottled it while hot in small bottles, which were then tied over with bladder. The juice kept good for many months.

Mr. SCHACHT wondered what became of the citric acid which had disappeared.

Professor ATTFIELD thought that the disappearance of citric acid, by conversion into glucose and other bodies, was one of the most important of Mr. Stoddart's observations, and should receive further attention. He hoped that members of the medical profession would institute experiments to decide whether the citric acid was the efficient agent, or the salts of potassium.

Mr. GROVES said that the fruiterers recognised what they call *sweet lemons*. Had Mr. Stoddart met with some of these? He had reserved lemon-juice throughout the year by adding two minims of chloroform to a fluid ounce of juice. When the juice was required for use, warmth was applied to evaporate the chloroform.

Mr. W. L. SCOTT had found acid oxalate of potash in lemon-juice in two instances, the amounts being 4 and 7½ per cent respectively.

Mr. STODDART said that the lemons which gave no citric acid had the appearance of being perfectly sound. He was aware that in Italy there were sweet lemons, of which both the peel and the juice were eaten. As to what became of the citric acid, he found that as it diminished the amount of sugar increased. He had proved that carbonic acid was formed and eliminated through the rind of the fruit by means of an air pump and lime-water. He had never met with oxalic acid in lemon-juice.

PURIFICATION OF SEWAGE.

MR. SILLAR'S PROCESS.

BY DR. FRANKLAND, F.R.S.

THE following report has been issued from the Rivers' Commission Laboratory:—

The analysis of the samples of sewage and precipitated mud taken during the recent experiments on the application of Mr. Sillar's process to the purification of the sewage of the town of Leicester, are now complete, and I herewith enclose the results in a tabulated form.

The Leicester sewage, as you are aware, has for some years past been deodorized with lime, and for the carrying out of the experiments which were shown to us, the plant was so arranged that one-half of the sewage could still be treated with lime as usual, whilst the remaining half was submitted to Mr. Sillar's new process. In this way I have been able not only to ascertain the extent to which the sewage was ameliorated by the new process, but also the comparative effect of the old lime process when applied to one-half of the same sewage.

The experiments extended over three days. On the first day a sample of the sewage as it arrived at the deodorising works was taken at 1.30 p.m., whilst at 5.40 p.m. and 6.10 p.m., samples of the effluent liquid, after treatment by the lime and Sillar processes respec-

tively, were collected, the intervals of time being those calculated as necessary for the passage of the sewage through each of the two processes. On the second day hourly samples of the raw sewage were taken from 10 a.m. to 9 p.m., but during the morning an accident happened to a portion of the apparatus which vitiated the experimental results, and consequently the samples, after treatment, were only taken from 4 p.m. to 8 p.m., in the case of the lime process, and from 4 p.m. to 9 p.m. in that of Sillar's process. On the third day all the samples were taken hourly from 10 a.m. to 5 p.m. After our departure from Leicester on the first day the duty of taking the samples was entrusted to Mr. W. Thorp, the principal assistant in this laboratory.

Before proceeding to interpret the results of the analysis, it is necessary to premise that the strength of sewage, as regards dissolved constituents, is determined by two analytical estimations—viz., "total solid impurity," and "total combined nitrogen." A comparison of the numbers under these heads, obtained from the samples of raw sewage, collected on each of the three days of the experiments, and on the occasion of our previous visit to Leicester (May 13th, 1868), shows that the sewage of this town is much below the average strength, and that it does not seem to vary in strength between very wide limits.

	May 13. lbs.	July 30. lbs.	July 31. lbs.	Aug. 1. lbs.
Total solid impurity in 100,000 lbs. of sewage	107.5	111.0	112.0	108.0
Total combined nitrogen in 100,000 lbs. of sewage	0.524	2.102	2.229	2.014

But although the strength of the sewage separated from suspended matter was thus tolerably uniform, its quality on the last day of the experiments differed widely from that which it possessed on the previous occasions; the organic matter, in the sample collected on the third day, having become so much decomposed that a large proportion of the nitrogenous constituents had become converted into mineral compounds. This anomaly in the sewage of the 1st of August is clearly seen from the following comparison of the organic carbon and nitrogen contained in the different samples of raw sewage after filtration from suspended matters:—

	May 13. lbs.	July 30. lbs.	July 31. lbs.	Aug. 1. lbs.
Organic carbon in 100,000 lbs. of sewage	2.017	3.745	3.536	2.752
Organic nitrogen in 100,000 lbs. of sewage	0.809	0.722	0.747	0.103

The purification of sewage may be conveniently considered under two heads—1st, clarification, or the removal of suspended matters, so as to make the resulting liquid more or less clear and transparent; and 2nd, removal of matters in solution. The suspended matters contained in sewage are well known to undergo rapid putrefaction and to become very offensive; consequently their removal either by filtration or chemical treatment constitutes in itself an important amelioration in sewage. But the liquid so clarified contains in solution much nitrogenous organic matter, which is prone to become putrid even when mixed with a considerable volume of river water.

In regard to clarification, the experiments at Leicester scarcely establish a decided superiority for Mr. Sillar's process over the method of treatment by lime. On the first day the effluent liquids were nearly equally clear; on the second day the limed sewage was markedly superior to its rival; whilst on the third day

the sewage treated by the new process was much clearer than the limed liquid. These statements rest on the following comparison of the quantities of suspended matter remaining in 100,000 lbs. of the effluent sewage as well as upon ocular observations made during the three days' experiments:—

SUSPENDED MATTER.

	After Lime Process. lbs.	After Sillar's Process lbs.
1st day	6.00	6.12
2nd "	2.84	4.36
3d "	6.56	2.76

Of the soluble constituents of sewage, the most important are those given in the accompanying analytical results under the heads "Total Solid Impurity," "Organic Carbon," and "Organic Nitrogen," and the following table shows the manner in which the sewage is altered in these three respects by being submitted to the two processes. The numbers all refer as usual to 100,000 lbs. of sewage.

	TOTAL SOLID IMPURITY.		ORGANIC CARBON.		ORGANIC NITROGEN.	
	Removed. lbs.	Added. lbs.	Removed. lbs.	Added. lbs.	Removed. lbs.	Added. lbs.
LIME PROCESS.						
1st day	23.0	—	8.75	4.75	—	—
2d "	22.0	—	9.28	4.07	—	—
3rd "	11.0	—	5.19	—	0.56	—
SILLAR'S PROCESS.						
1st day	—	6.0	9.67	4.25	—	—
2nd "	—	13.0	12.31	3.74	—	—
3rd "	—	11.0	7.13	—	1.93	—

The numbers show that, whilst the lime process considerably reduces the amount of dissolved impurities in sewage, Sillar's process markedly augments it. The explanation is obvious: in the lime process, which is in fact an application of the late Professor Clarke's ingenious method of softening water, all the material added in solution is again precipitated in the solid form; but in Sillar's process considerable quantities of dissolved chemicals are added which are not afterwards precipitated. It is also probable that in both processes certain constituents present in the suspended matter of the raw sewage are dissolved, whilst other constituents already in solution are precipitated; there is thus finally left in solution a balance of solid matter which in the case of lime is less, but in the case of a new material greater, than the amount present in the raw sewage.

Both processes have the effect of diminishing the organic carbon, and on each of the three days the diminution effected by Sillar's process was markedly in excess of that brought about by the lime process.

The material, however, which it is of the greatest importance to remove from the dissolved constituents of sewage, is nitrogenous organic matter, because it is chiefly this kind of organic matter which enters rapidly into putrefaction, and becomes an active agent in the pollution of rivers. This material is represented in the analytical results by organic nitrogen. It is precisely here that both processes signally fail (although the lime is slightly superior to the new process) in accomplishing such an amount of purification as would render the sewage admissible into an open water-course. The raw sewage on the third day was, as already mentioned, very far advanced in decomposition, and the effect of both processes upon this sewage was actually to increase the amount of organic nitrogen in solution; that is, the amount of organic nitrogen dissolved from

the suspended matter of the raw sewage was greater than that precipitated by the chemical reagents added. Leaving out of consideration this result, which must be regarded as abnormal, the following table shows the amelioration effected by the two processes:—

PERCENTAGE OF ORGANIC NITROGEN REMOVED.

	Lime Process.	Sillar's Process.
1st day.....	65.79.....	58.86
2nd day.....	54.48.....	50.07

It may be stated, therefore, in round numbers, that, as regards putrescible organic matter, the application of either process would render it possible to double the amount of filtered sewage admitted into a river without increasing the pollution. Although this is by no means an unimportant result, yet it falls far short of what is required to restore our sewage-polluted rivers to a satisfactory degree of purity.

An inspection of the analytical table shows that the effluent sewage, after treatment by the new process, invariably contains more ammonia than the raw sewage; thus, on the first day 100,000 lbs. of sewage contained 1650 lbs. of ammonia before treatment, and 2 lbs. after treatment; on the second day, 1.8 lbs. before and 2.5 lbs. after treatment; whilst on the third day, it contained 2.25 lbs. before and 2.5 after treatment. The origin of this additional ammonia is not difficult to understand; in the first place, alum enters largely into the composition of the material used in the new process; but as nearly all alum now manufactured is ammonia-alum, containing 37 per cent of ammonia, it is probable that this is one source of the additional quantity of the ammonia; but it cannot be the only source, unless we are to assume the use of such a large proportion as would render the process economically impracticable. The second, and probably the chief source of the additional ammonia is to be sought for in the action of the chemical reagents upon the nitrogenous organic matters contained in the raw sewage, partly in suspension and partly in solution. The possibility of such a liberation of ammonia is seen in the case of the limed sewage of the first day; here no ammonia was added in the reagent; nevertheless there was an increase of 475 lbs. in each 100,000 lbs. of sewage. Such an addition to the amount of dissolved ammonia has little significance as regards the pollution of rivers, but it has an important bearing upon the applicability of the process to the economical production of a solid manure, because it indicates not only that the ammonia already in solution in the raw sewage is not precipitated, but also that some of the suspended nitrogenous matter is decomposed with the liberation of ammonia, representing so much valuable matter abstracted from the solid manure.

Notwithstanding this loss of nitrogenous organic matter in process of deodorisation, the new method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the mud from the new process being acid, whilst the lime mud is alkaline; consequently, in drying, the latter loses ammonia, whilst the former, if still further acidified, cannot suffer this loss.

Both samples of mud submitted to analysis were first dried in the sun, with free exposure to the air, so as to imitate, as nearly as may be, the process of drying such manure usually employed on the large scale. By analysis the following results, expressed in percentage numbers, were obtained:—

	Dry Mud from Sillar's Process.	Dry Mud from Lime Process.
Mineral matters.....	54.772.....	37.413
Organic and other volatile matters.....	45.228.....	62.587
Carbon.....	24.994.....	18.865
Phosphoric acid.....	.496.....	.147
Total nitrogen.....	1.943.....	.849
Ammonia.....	.185.....	.090

It is thus evident that in the three valuable constituents of manure—viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid—the manure obtained by the new process is greatly superior to that resulting from the treatment with lime. Unfortunately some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the new process, because bone-black in, to me, unknown quantity enters into the composition of the precipitating material used by Mr. Sillar, and thus a certain amount of phosphoric acid is added to that which is actually derived from the sewage.

I estimate the value of the two manures as follows:—

	Per Ton. £ s. d.
Manure from lime process.....	0 13 6½
Manure from Sillar's process.....	1 13 6½

The value of the solid manure obtained by treating the Leicester sewage with lime has already been estimated, from the analysis of Voelcker and Versmann, by Hofmann and Witt, who give the following numbers: *—

	Voelcker. s. d.	Versmann. s. d.
Value per ton.....	15 5.....	17 0

That these values exceed my estimate is partly due to the circumstance that Hofmann and Witt assigned a value of £1 a ton to non-nitrogenous organic matter, whilst I regard it as worthless. Such is the value of these deposits as estimated from chemical analysis; but experience has warned the manufacturer of these feeble manures that the value indicated by chemical analysis cannot be counted upon in the market. Thus the Leicester mud is actually sold for 1s. per ton, although its indicated value is 13s. 6½d.

In conclusion, the results of the experiments may be thus summarized:—

1. The Sillar and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

2. Sillar's process increases the amount of dissolved solid impurity in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid impurity and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar's process—viz., rather more than one-half.

3. Like all chemical methods hitherto invented, both processes fail in purifying sewage to such an extent as to render it admissible into running water. It still remains a fact, that no chemical process is known which even remotely approaches irrigation in its efficiency as a purifier of sewage.

4. For the manufacture of solid manure from sewage, Sillar's process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents.

* Report on the Main Drainage of the Metropolis, by Hofmann and Witt, 1857, page 19.

ON FOOD.*

BY DR. LETHEBY, M.A., M.D., &c.

(Continued from *Am. Repr.*, Dec. 1863, page 304.)

Constructions of Dietaries: Preparation and Culinary Treatment of Foods.

THE construction of dietaries for particular purposes as for training, for developing muscular tissue, for producing fat, or for reducing it, is beyond the scope of these lectures; but it may be generally said that, as in training the object is to form muscular tissue, to give it great endurance of action, and at the same time to reduce the weight of the body, it is accomplished by the use of nitrogenous food, with but little fat or farinaceous matter, and as little fluid as possible—so that muscular tissue may take the place of fat and water; and by constant exercise, the endurance and strength of the muscular tissue is increased, and the proportion of water in the tissues is reduced. King, in training, is said to have taken for his breakfast two lean mutton chops, somewhat underdone, with dry toast or stale bread, and a single cup of tea without sugar; for dinner, 1 lb. or 1½ lb. of beef or mutton, with toast or stale bread, and very little potato or other vegetable, and half-a-pint of old ale, or a glass or two of sherry; for tea, a single cup of unsweetened tea, with an egg and some dry toast; and for supper half-a-pint of oatmeal-porridge or half-a-pint of old ale. The effect of this is to produce only a short-lived state of effectiveness; for, carried a little beyond the appointed time, it leads to disease; and even after the trial, there is often, as in the case of Heenan, terrible prostration of the system, and a necessity for returning immediately to an ordinary diet.

Foremost among the foods for developing fatty tissue are fats—as fat of meat, butter, cream, &c.; next to these are farinaceous matters—as arrowroot, starches, and the various meals; and after these are sugar, alcohol, &c.; so that in an attempt to reduce the bulk of the body, all of them, but especially the first, should be but sparingly used. Conversely, however, the use of fatty and farinaceous foods has a tendency to produce fat, and so also with fermented liquors, as beer and porter—the last having a high character for its capabilities of forming milk when drunk by nursing-women.

In associating different articles of diet, so as to secure the right proportions of the several constituents of food—fat, sugar, or starch, and nitrogenous matter, we find that we may not only rely on the sound indications of science, but may also trust, and trust safely, to the unerring guidance of our instincts—provided they have not been vitiated by fashion or perverted by evil habits. Science teaches us that the best proportions for the common wants of the animal system are about 9 of fat, 22 of flesh-forming substances, and 69 of starch and sugar; and experience also shows that these are the very proportions which we are constantly striving to maintain in our daily dietaries. Borrowing largely from the graphic illustrations of Liebig and Johnston, I may state that, whenever one kind of food is wanting in any particular constituents we invariably associate it with another that contains an excess of it. Certain meats, for example, which are deficient of fat are always eaten with substances that are rich in it—bacon is associated with veal, with liver, and with fowl, or we capon the latter, and thus increase its natural fat. We

use melted butter with most kinds of fish, or we fry them in oil; while the herring, the salmon, and the eel are usually fat enough in themselves, and are dressed and eaten alone. It is with a view to a similar adjustment that we mix eggs and butter with sago, tapioca, and rice; that we add oil and the yolk of an egg to salad; that we boil rice with milk, and eat cheese with macaroni. The same instinct has determined the use of vegetables with meat and butter with bread. Bacon and greens, or beans and bacon, like pork and peas-pudding, is a conjunction of viands which does not owe its popularity to old habit or the mere taste of the epicure; and so with a dish common in Ireland, under the name of Kol-cannon; the potato, which is poor in gluten, and the cabbage, which is usually rich in this ingredient, are mixed together, and thus they approach the composition of wheaten bread, but both of these substances are deficient in fat; add, therefore, a little bacon or fat pork to the mixture, and you have a Kol-cannon which has all the good qualities of the best Scotch oatmeal, and to many it is more savoury and palatable. Again, the mixture so usual in Ireland and Alsace, of the butter-milk or curdled milk and potatoes, and the combinations of rice and fat which make the diet of Eastern nations; even the little dab of butter upon the poor man's potato, and the bit of cheese that he eats with his dinner, are matters not of luxury but of necessity, and they show how by long experience we have at last learnt to adjust the proximate constituents of food, so as best to maintain the health and vigour of the body.

And then, again, the times for taking food, and the proper distribution of it in appropriate meals, are questions of considerable importance, notwithstanding that they have ever been influenced by the caprices of fashion and the artificial habits of society. How much they have to do with the modification of the human species, and even the extinction of whole races of men, is an etiological problem of much interest.

Man, in his savage condition, feeds with great irregularity, for when he finds that food is plentiful he eats from morning till night, and knows no other pleasure than eating and drinking and sleeping; but when it is more scarce he is content with a single meal a day. In both cases, however, the quantity of food consumed is excessive. We are told by travellers that the Hottentots, the Bushmen, and the inhabitants of South Africa, who feed in this manner, are enormous gluttons. "Ten of them," says Barrow, "ate, in his presence, an ox, all but the hind legs, in three days; and the three Bosjesmen that accompanied his waggon, devoured a sheep on one occasion in less than twenty-four hours." Parry, Ross, and others, have also given the most astonishing accounts of the dietetical capabilities of the Esquimaux. Captain Parry once tried the capacity of a young lad scarcely full grown, and in twenty-four hours he had eaten 4 lbs. 4 ozs. of the raw hard-frozen flesh of a sea-horse, the same quantity of it boiled, 1 lb. 12 ozs. of bread and bread-dust, besides a pint and a quarter of rich gravy-soup, a tumbler of strong grog, three wine-glasses of raw spirits, and nine pints of water. According to Sir John Ross, the daily rations of an Esquimaux are 20 lbs. of flesh and blubber. But the most marvellous example of gluttony is given by Captain Cochrane, on the authority of the Russian Admiral Saritcheff, who was told that one of the Yakuti had consumed the hind quarter of a large ox in twenty-four hours, together with 20 lbs. of fat, and a proportionable quantity of melted butter. To test the truth of this, he gave him a thick porridge of rice

* The Cantor Lectures, delivered before the Society of Arts.

boiled down with 3 lbs. of melted butter, weighing together 28 lbs.; although the glutton had already breakfasted, yet he sat down to the meal with great eagerness, and consumed the whole without stirring from the spot; and, except that his stomach betrayed more than ordinary fullness, he showed no sign of inconvenience. Captain Cochrane further adds that a good calf, weighing 200 lbs., will just serve for a meal for four or five Yakuti; and that he has himself seen three of them consume a reindeer at a meal. Liebig accounts for this by saying that a nation of hunters, especially when they go naked and are exposed to great losses of temperature, must consume large quantities of respiratory food; and if it so happens that the food is in its least effective form, as lean flesh, the quantity disposed of is enormous.

Among civilised nations, and until comparatively recent times, there were but two meals a day—viz., dinner and supper. These were the meals of the Romans—the prandium or dinner being for the most part a light refreshment, eaten while standing, at about nine o'clock in the morning; and it generally consisted of the cold remains of yesterday's supper. It was commonly taken without wine; and, in fact, there was so little ceremony about it, that Plautus, in his comedies, has facetiously called it *caninum prandium*. The great meal of the day was the supper, or *cæna*, which was taken about three or four o'clock in the afternoon, and to which friends were invited. This was the ceremonious meal for which the wealthy and high families of Rome exhausted the resources of luxury and art. It always consisted of three parts—the *gustus* or antipast, which was intended as a mere smack or relish to whet the appetite. Then came the main part of the feast—consisting of many courses, with a chief dish, or *caput cænæ*, and when in thrifty families it was the only dish which went the round of the frugal board, it was aptly termed the *cæna ambulans*. After this there came the second course, or *menia secunda*, composed of fruits and pastry, like a modern dessert.

The sums of money expended by the wealthy Romans on this meal were often ruinous. Vitellius is said to have spent as much as 400 *sestertia* (about 3,228*l.* of our money) on his daily supper; and the celebrated feast to which he invited his brother Lucius cost no less than 5,000 *sestertia*, or 40,350*l.* sterling. It consisted, according to Suetonius, of 2,000 different dishes of fish, and 7,000 of fowls, with other equally numerous meats. His daily food, says our classical writer, was of the most rare and exquisite nature, the deserts of Libya, the shores of Spain, the waters of the Carpathian Sea, and even the coasts and forests of Britain, were diligently searched for dainties to supply his table; and had he reigned long he would, says Josephus, have exhausted the great opulence of the Roman Empire. Ælius Verus, another of those worthies, was hardly less profuse in the extravagance of his suppers; for it is said that a single entertainment, to which only about a dozen guests were invited, cost above 6,000,000 *sesterces* (6,000 *sestertia*, or nearly 48,500*l.*); and we are told by historians that his whole life was wasted in eating and drinking—being spent in the voluptuous retreats of Daphne, or else at the luxurious banquets of Antioch. So profuse, indeed, was the extravagance of those times, that to entertain an emperor at a feast was to encounter almost certain financial ruin—one dish alone at the table of Heliogabalus has been known to cost about 4,000*l.* of our money;

no wonder, therefore, that these imperial feasts were lengthened out for hours together, and that every artifice, often revolting in the extreme, was used to prolong the pleasure of eating, or that Philoxenus should have wished that he had the throat of a crane with a delicate palate all the way down.

Hardly less extravagant were the dining propensities of our own forefathers, who in every way copied too closely the luxurious habits of their Roman conquerors. In fact no circumstance, as Mr. Wright observes, is more remarkable in ancient history than the readiness with which the people who came under the sway and influence of Rome, abandoned their nationality, and followed the luxurious habits of their rulers. Even so late as the time of Holinshed, the famous chronicler of the sixteenth century, the manners of the English were the subject of severe comment; for he tells us that "in number of dishes and changes of meat, the nobility of England (whose cooks are for the most part musical-headed Frenchmen and foreigners) do most exceed; with there is no day in manner that passeth over their heads, wherein they have not only beef, mutton, veal, lamb, kid, pork, cony, capon, pig, or so many of them as the season yieldeth, but also some portion of the red and fallow deer, beside great variety of fish and wild fowl, and thereto sundry other delicacies, wherein the sweet hand of the seafaring Portingale is not wanting; so that for a man to dine with one of them, and to taste of every dish that standeth before him, is rather to yield unto a conspiracy with a great deal of meat for the speedy suppression of natural health, than the use of a necessary meal to satisfy himself with a competent repast to sustain his body withal." He adds, too, "that gentlemen and merchants keep much about the same rate; and when they make their ordinary or voluntary feasts, it is a world to see what great provision is made of all manner of delicate meats from every quarter of the country, wherein, beside that, they are often comparable herein to the nobility of the land; so that they will seldom regard anything that the butcher usually killeth, but reject the same as not worthy to come in place. In such cases, also, gelifies of all colours, mixed with a variety in the representation of sundry flowers, herbs, trees, forms of beasts, fish, fowls, and fruits; and thereunto march-pane, wrought with no small curiosity, tarts of divers hues and sundry denominations; conserves of old fruits, foreign and home-bred; suckets, codiniacs, marmalades, sugarbread, gingerbread, florentines, wild-fowl, venison of all sorts, and sundry outlandish confections, altogether seasoned with sugar, besides infinite devices, not possible for me to remember."

The learned Caius, also, in his "Counsell against the Sweat" of the same century (1552) comments in severe terms on the gluttony of his time, saying that the reason why the disease attacks the English more than others is, that they have "so moche sweating stuffe, so many euille humoures laid up in store, fro this displeasante, feareful, and pestilent disease, cause of their euille diet, whiche destroy more meates and drynckes without al ordre, convenient time, reason, or necessite, the either Scotlande or al other countries under the sunne."

Gradually, too, as the dinner got to be later in the day, and reached noontime, there was necessity for a light early meal, or breakfast, as it was called; and as the dinner became later and later still, a fourth meal was added—the lunch or luncheon, which literally meant a slice of bread. In process of time, also, with

the introduction of tea and coffee into England, there came a fifth meal; but all along the dinner was the great feast of the day; and the rule in using it was pretty much as Dr. Kitchener, in his time, advised—viz., to eat until there was a sense of satiety, the stimulus of every fresh dish being but as a whip to the appetite, so that the sense of satiety might come and go a dozen times. "It is produced in us," says Christopher North, "by three platefuls of hotch-potch, and to the eyes of an ordinary observer our dinner would seem to be at an end; but no—strictly speaking, it is just going to begin. About an hour ago did we, standing on the very beautiful bridge of Perth, see that identical salmon, with his back fin just visible above the translucent tide, arrowing up the Tay, bold as a bridegroom, and nothing doubting that he should spend his honeymoon among the gravel-beds of Kinnaird or Moulenearn, or the rocky sofas of the Tummel, or the green marble couches of the Tilt. What has now become of the sense of satiety? John—the castors!—mustard—vinegar—cayenne—catsup—peas and potatoes, with a very little butter—the biscuit called "rusk"—and the memory of the hotch-potch is as that of Babylon the great." Sense of satiety, indeed!—"We have seen it for a moment existing on the disappearance of the hotch-potch—dying on the appearance of the Tay salmon—once more noticeable as the last plate of the noble fish melted away—extinguished suddenly by the vision of the venison—again felt for an instant, and but for an instant, for a brace and a half of as fine grouse as ever expanded their voluptuous bosoms to be devoured by hungry love."

We smile at the accounts given of the gormandizing powers of the natives of Arctic regions and the savages of Southern Africa, but our own habits in eating and drinking are scarcely less preposterous. Look at a modern dinner; beginning with soup, and perhaps a glass of cold punch; to be followed by a piece of turbot or a slice of salmon with lobster-sauce; and while the *caput canis*, the venison or South down, is getting ready, we toy with an oyster paté or a bit of sweetbread, and mellow it with a bumper of Madeira. No sooner is the venison or mutton disposed of, with its never-failing accompaniments of jelly and vegetables, than we set the whole of it in a ferment with champagne, and drown it with hock or sauterne. These are quickly followed by the wing and breast of a partridge, or a bit of pheasant or wild duck; and when the stomach is all on fire with excitement, we cool it for an instant with a piece of iced pudding, and then immediately lash it into a fever with undiluted alcohol, in the form of cognac or a strong liqueur; after which there comes a spoonful or so of jelly as an emollient, a morsel of ripe stilton or paté de foie-gras as a digestant, a piquante salad to whet the appetite for wine, and a glass of old port to persuade the stomach, if it can, into quietness. All these are more leisurely succeeded by the *mensa secunda*, or dessert, with its ices, its preserves, its bake-meats, its fruits, its geliffes, codiniacs, and suckets, as Holinshed would call them, and its strong drinks; to be afterwards muddled with coffee, and complicated into a rare mixture with tea, floating with the richest of cream.

As a modest example of this sort of thing, and an indication moreover of the kind of novelties yet in store for us, let me read to you the *menu* of a late dinner at the Langham, where horse-flesh was the principal *vivande*. It is very appropriately prefaced with a little bit of French philosophy—"Les préjugés sont des maladies de l'esprit humain."

"*Potages*—Consommé de cheval. A la purée de destrier. *Amontillado*.

"*Poissons*—Saumon à la sauce Arabe. Filets de soles à l'huile hippophagique. *Vin du Rhin*.

"*Hors d'œuvres*—Terrines de foie maigre chevalines. Saucis-ons de cheval aux pistaches syriennes. *Xérès*.

"*Relevés*—Filet de l'église rôti aux pommes de terre à la crème. Dinde aux châtaignes. Aloyau de cheval farci à la centaure aux choux de Bruxelles. Culotte de cheval braisée aux chevaux-de-frise. *Champagne sec*.

"*Entrées*—Petits pâtés à la moelle Bucéphale, Kromesky à la Gladiateur. Poulets garnis à l'hippogriffe. Langues de cheval à la Troyenne. *Chateau Perayne*.

"SECOND SERVICE.

"*Rots*—Canards sauvages. Pluviers. *Volney*. Mayonnaises de homard à l'huile Rosinante. Petits pois à la Française. Choux-fleurs au parmesan.

"*Entremets*—Gelée de pieds de cheval au marasquin. Zephirs sautés à l'huile chevaleresque. Gateau vétérinaire à la Ducroix. Feuillantines aux pommes des Hesperides. *St. Peray*.

"*Glaces*—Crème aux truffes. Sorbets contre-préjugés. *Liqueurs*.

"*Dessert*—Vins de fins Bordeaux. Madère. Café.

"*Buffet*—Collared horse-head. Baron of horse. Boiled withers."

Even put into plain English all this would sound remarkable, and taken, as it is said to have been, without shying or gibbing, although, perhaps with a little bolting, it must have puzzled the stomach; and, like all our modern dinners, must also have severely taxed its powers in selecting from the complicated mess, the right portions of fat and flesh, and farinaceous matter required for the sustenance of the body.

Nor is it right to content ourselves, like savages, with a single meal a day, as was the custom of Dr. Fordyce, the celebrated professor of chemistry of the last century. Studying the habits of carnivorous animals, and reflecting on the principles of chemistry and physiology, he came to the conclusion that man required but one meal a day for all his physiological wants, and for more than twenty years his daily dinner was as follows:—Regularly at four o'clock of an afternoon he would present himself at "Dolly's Chop House," and take his seat at the table reserved for him. Immediately on his arrival the cook would place a pound and a half of rump-steak upon the gridiron, and while it was cooking the doctor would amuse himself with some such trifle as half a broiled capon, or a plate of fish, and a glass or two of brandy—his regular allowance being a quarter of a pint. Then came the steak with a full accompaniment of bread and potato, and it was always served with a quart tankard of strong ale. This was followed by a bottle of old port; and, when the dinner was finished, as it invariably was in an hour and a half, he walked leisurely to his rooms in Essex Street in the Strand, where he met his class and gave his lecture on chemistry.

But these are not habits of the great bulk of mankind, and although they may have been practised for a while with impunity, yet they serve not as illustrations of what ought to be done in the way of eating, but rather as examples of the wonderfully accommodating power of the stomach under the most disadvantageous circumstances; for experience teaches us that three meals a day, of the simplest quality, are best suited for our wants—breakfast to supply the want of long fasting, and to restore the waste of secretion during the night; dinner in the middle of the day to support the system

during the fatigue of ordinary labour; and a light meal at night, in the form of tea or an early supper, to carry on the functions of repair and secretion during the night. According to Dr. Edward Smith, the daily distribution of the food, supposing a physiological diet of 4,300 grains of carbon, with 200 grains of nitrogen to be taken, should be somewhat in this manner:—

	Carbon. grs.	Nitrogen. grs.
For Breakfast.....	1,500	70
For Dinner.....	1,800	90
For Supper.....	1,000	40
Total in the day	4,300	200

So that about one part should be eaten for supper, one and a half for breakfast, and about two parts for dinner.

It is hardly necessary to say, that in constructing dietaries, the foods should be associated in such a way as not to offend the appetite or burden the digestive powers; and that they should also be varied from time to time, not merely in their kind, but also in their treatment, as in the manner of cooking and flavouring them; for the best descriptions of food will, if eaten in the same fashion day after day, occasion disgust, and be wasted. This is often the case in the badly-arranged dietaries of workhouses, and on ship-board. It was once so with the dietaries of the English army, when the same daily rations of boiled meat were provokingly served out to the men, while they listened to the tune of "Oh the roast-beef of old England." All this is easily provided for, and it is true economy to do so, by varying the food, the mode of cooking it, the manner of flavouring it, and by serving it, in the case of dinner, with different kinds of vegetables. In constructing dietaries, therefore, the main considerations are the due supply of the right proportions of nitrogenous and carbonaceous matters; for when these are not adjusted in a proper manner, the health is endangered, and the constitution may be slowly undermined. To use the words of Liebig—"there is a law of nature which regulates these things, and it is the elevated mission of science to bring this law home to our minds; it is her duty to show why man and animals require such admixture in the constituents of their food for the support of the vital functions, and what the influences are which determine, in accordance with the natural law, changes in the admixture.

"The knowledge of the law elevates man in regard to an important function which he possesses in common with the lower animals, above the level of those beings which are destitute of reason, and supplies him, in the regulation of those bodily wants which are essential to his existence and prosperity, with a protection which the lower animals do not require, because in them the commands of the instinctive law are not opposed or overpowered by the allurements of sense, or by a perverted and resisting will."

The recognition of this law, and the practical application of it to the dietaries of a community, are obviously of great advantage, for not only would they tend to increase the health and strength of the population, but they would also effect a great economy in the general use of food. That there are difficulties in the way of such an application cannot be doubted; in fact, the natural peculiarities of individuals, to say nothing of the differences of occupation, and the ever-varying quality of the food itself, are enough to create a doubt as to the possibility of its general application until the progress of science has gone far beyond its present position. Never-

theless, there are certain well-acknowledged facts at our disposal which may safely serve as a guide to practice.

The diseases which are incidental to an abuse of the law can hardly be discussed in this place, but it may be said, in general terms, that too much or too little of either of the main constituents of food will soon be followed by marked derangements of the animal body. An excess of respiratory food not only promotes the growth of fat, but actually interferes with the nourishment of muscular tissue. Those who feed largely on rice, on potatoes, or other farinaceous food, or who indulge too freely in malt liquors, have commonly a bloated appearance, and have no faculty for sustained exertion. The brewer's drayman, for example, is a bad subject for the ward of a hospital; and although he sometimes looks strong and muscular, yet in reality his vital power is feeble, and his tissues are fatty rather than muscular. The same is often the case with animals in the Zoological Gardens, when too large a quantity of respiratory food has been eaten, and their flesh has undergone a kind of fatty degeneration.

On the other hand, when the plastic elements of the food are in excess, the system becomes excited, too much blood is formed, and diseases of a plethoric character are induced. According to Liebig and his followers, an excess of force is developed, which manifests itself in irritability of temper, and in a savage disposition. How far this may be concerned in the frequently ungovernable conduct of our over-fed convicts may be deserving of consideration. A nation of animal feeders, says Liebig, is always a nation of hunters, for the use of a rich nitrogenous diet demands an expenditure of power, and a large amount of physical exertion, and this is seen in the restless disposition of all the carnivora of our menageries.

A deficiency of food, however, is quickly followed by a general breaking up of the animal frame. Plague, pestilence, and famine are always associated in the public mind; and the records of every country show how closely they are related. The medical history of Ireland is remarkable for illustrations of how much mischief may be occasioned by a general deficiency of food. Always the habitat of fever, it every now and then becomes the very hotbed of its development. Let there be but a small failure in the usual imperfect supply of food, and the lurking seeds of pestilence burst into frightful activity. The famine of the present century is but a too forcible illustration of this, for it produced epidemics which had not been witnessed in this generation, and it gave rise to scenes of devastation and misery which are not surpassed by the most appalling of the middle age. The principal form of the scourge was known as the contagious famine fever, and it spread, not merely from end to end of the country in which it had originated, but, breaking through all boundaries, it crossed the broad ocean, and made itself painfully manifest in localities where it was previously unknown. Thousands fell under the virulence of its action, for wheresoever it came it struck down a seventh of the people, and of those whom it attacked one out of nine perished. Even those escaped the fatal influence of it were left the miserable victims of scurvy and low fever. Another example, not less striking, of the terrible consequences of what may be truly called famine, was the condition of our troops during the early part of their sojourn in the Crimea. With only just enough of food to maintain the integrity of the system at a time of repose, and at ordinary temperatures, they were called upon to make large muscular exertions, and to sustain the warmth of

the system in the midst of severe cold. What could be expected but that the scourges which wait upon famine, as fever, diarrhoea, dysentery, and scurvy, should make their appearance in great force, and that the soldiers should perish by thousands. With an average strength of 24,000 men, the deaths from sickness alone, in the course of seven months, were at the rate of thirty-nine per cent, and in some cases it amounted to seventy-three. "Never before," says Colonel Tulloch, "is there record of a British army having sustained so frightful a loss in so short a time." During the Peninsular war, though the troops occasionally suffered much from sickness, the loss from that cause did not average above 12 per cent for a whole year. Even in the ill-fated expedition to Walcheren, which threw the nation into mourning, the deaths amounted to only about 10½ per cent for the half year; and here, in this great city, with all the aggravating circumstances of want, vice, infancy, old age, and disease, it did not reach 2 per cent during the time that our strong men were dying by thousands. "Armies have perished by the sword, and have been overwhelmed by the elements, but never, perhaps," says Colonel Tulloch, "since the hand of the Lord smote the host of the Assyrians, and they perished in a night, has such a loss from disease been recorded as on this occasion." May the lesson of so great a calamity be wisely applied in the future.

The connection of scurvy with improper or insufficient food is a matter of medical history, and its prevention by the use of fresh vegetables, especially potatoes, is so well known that it has often been the subject of legislation. Rarely appearing in the cabin, where the dietary is good, it is a frequent visitor to the fore-castle; so that half the men of our sea-going vessels are found to be suffering from the disease when they return to port. As many, indeed, as 70 per cent of a ship's crew are not unfrequently disabled by it; and there is no saying how many of the disasters at sea are caused by the inability of the men to work the vessel in times of severe weather. The legal supplementary allowance in emigrant vessels of 8 ozs. of preserved potato, 3 ozs. of other preserved vegetables (carrots, turnips, onions, celery, and mint), besides pickles, and 3 ozs. of lemon-juice for each person weekly, is found to be a perfect prophylactic of the disease, so that the one essential cause of it is evidently a privation of vegetable food.

And not less important are the morbid results of too much or too little saline matter in the food. I have already spoken of the salutary effect of certain calcareous salts in the water we drink; but according to Dr. Grange, the presence of magnesian salts in the water of a district may have something to do with the development of those remarkable forms of disease which are known as goitre and cretinism. In France, Germany, England, Sardinia, among all classes of people, of all habits, and in every variety of climate, those diseases are endemic where the soil is composed of magnesian rock, and the water charged with magnesian salts. How far the connection extends is a chemico-physiological problem that has yet to be determined.

In the treatment of vegetable foods it is moreover of importance to remember that all corky and woody tissues, as the skins of fruits, tubers, and cereals, are quite indigestible, and that in consequence of their irritating action they hurry food through the alimentary canal, and so occasion waste. It is necessary, therefore, that all such tissues should be removed as completely as possible.

When it is required to obtain the starchy or farinaceous matters of vegetables, one or other of the following processes is followed:—

(a). The material is pulped or crushed, and diffused through a considerable volume of cold water. It is then strained and allowed to stand until the farina or starch subsides.

(b). Or it is allowed to pass into a state of putrefactive decomposition, whereby the albuminous matter, as the gluten, &c., decay and leave the starch untouched.

(c). Or it is subjected to the action of a weak alkaline solution, generally of caustic soda, which dissolves the gluten and allows the starch to subside. The gluten thus dissolved may be again recovered by neutralising the alkaline solution with acid, and collecting the precipitated gluten, as in the processes of Durand and others.

I have already explained that in the treatment of the ground meal of wheat and other grain the bran and coarser kinds of flour are separated by sieves of different degrees of fineness, and that in this manner about eight or nine varieties of product are obtained, as biscuit flour, best or fine household, seconds, tails, fine sharps or middlings, coarse sharps, fine pollard, coarse pollard, and long bran; the proportions of these from ordinary brown meal will vary according to circumstances, but processes have been invented, as by M. Mège Mouries, M. D'Arblay, and others, whereby the yield of fine flour is increased to 86 or even to 88 per cent of the grain, and by which the quantity of gluten is also regulated.

When the flour is rich in gluten, as in the case of the hard wheats of Sicily, Russia, Sardinia, and Egypt, they are well suited for the manufacture of certain granular powders and dried pastes, which are known as Semola, Semolina, Soujee, Mannacroup, Maccaroni, Vermicelli, and Cagliari paste. The last three are generally imported from Naples or Genoa, where they are made from a highly glutinous wheaten flour, by kneading it into a thin dough or tenacious paste, and then forcing it through holes or slits in a metallic plate. In this way the several varieties of pipe, celery, and ribbon maccaroni are obtained; and the fancy forms of it, called Cagliari paste, which are in the shape of stars, rings, Maltese crosses, &c., are produced by stamps. All these varieties of raw wheaten paste are cooked by boiling or baking, and are associated with soup or beef tea, or milk, or are mixed with eggs, cheese, &c.

The best variety of flour for bread is that which contains less gluten than the preceding, as from 8 to 10 per cent of it instead of from 12 to 14 or 15. Dantzic flour, and soft Spanish, as well as the American called Genesee, are the best examples of it, and are highly esteemed by bakers on account of the fine quality of bread which is procurable from them; the richer varieties of hard glutinous wheat being used only to impart strength to weak and inferior descriptions of flour.

Bread, which is the most important preparation of flour, owes its value as an article of diet to a good and equable vesiculation of the dough, the vesiculation being effected by the diffusion of small bubbles of carbonic acid gas throughout its substance; and, as this vesiculation can only take place in a proper manner when the gluten of the flour is in sufficient quantity, and of good quality, it is, to some extent, a test of the goodness of the meal. Those flours which contain too little gluten, or gluten which is deficient of strength, cannot be vesiculated into bread. This is the case with almost every description of flour, excepting that of wheat and rye.

The most common, and also the most ancient method of vesiculating bread is by fermentation; and the process is not very different from what it was in very early times, when we were told that "a little leaven leaveneth the whole lump." Yeast of some sort—as brewer's yeast; or patent yeast, prepared from infusion of malt and hops; or German yeast, which is the solid residue of the yeast produced by the fermentation of rye for making Hollands; or baker's yeast, which is made from potatoes and flour; or leaven, which is old dough in a state of fermentation, is mixed with the flour or dough, which soon begins to ferment by the action of the yeast fungus (*micoderma cerevisiae*) on the sugar of the flour. Carbonic acid is thus produced; and by being diffused through the substance of the dough, it vesiculates it, and causes it to rise or swell. The most usual practice with the baker is somewhat as follows:—A special ferment is prepared from mealy potatoes (technically called fruit) by boiling them in water, mashing them, and allowing them to cool to a temperature of about 80° Fahrenheit. Yeast is then added to them, together with a little flour to hasten the fermentation. In three or four hours, at a proper temperature (as from 80° to 90° Fahr.), the whole mass is generally in a state of active fermentation, with a sort of cauliflower head. It is then diluted with water and strained, and is mixed with sufficient flour to make a rather thin dough, which in about five hours rises to a fine sponge. This is again diluted with water containing salt, and is worked with the necessary quantity of flour into dough, and allowed to stand for two or three hours, when it rises, and is in a fit condition to be baked into loaves.

It can hardly be said that the potatoes are an adulteration in this case, for they do not ever amount to more than 6 lbs. to a sack of flour, which makes about 380 lbs. of bread, or 95 4-lb. loaves. The salt is added to the extent of about 4 lbs. or more to a sack of flour, the proportions being regulated according to circumstances, for the object of it is to improve the quality of the loaf as regards whiteness, firmness, and flavour.

There is, no doubt, a slight loss of nutritive matters by this mode of vesiculation, for a small portion of the sugar of the flour is converted into alcohol and carbonic acid, but the quantity is so inconsiderable as to be undeserving of notice. The advantage of the process, however, is that it is an excellent test of the quality of the flour; for weak flour, or flour that has been injured by germination, or by keeping, will not stand the action of yeast, but will be either ropy, or sticky, or heavy, when baked into bread.

Another method of vesiculation is to generate carbonic acid in the dough by the action of an acid on bicarbonate of soda. Dr. Whiting's process, which was patented in 1836, was to mix the carbonate of soda with the flour, and then to act on it with a proper proportion of muriatic acid added to the water. He used from 350 to 500 grains of carbonate of soda to 7 lbs. of flour, and to this he added 2½ pints of water charged with from 420 to 560 grains of muriatic acid. Other proportions are used by bakers who make unfermented bread; but in all cases the proportions should be such as to form common salt (which is the product of the action of muriatic acid on carbonate of soda)—the carbonic acid being liberated in the substance of the dough. Care should be taken that the muriatic acids pure, for that found in commerce is generally highly charged with arsenic.

In 1845, another acid was patented instead of muria-

tic—viz., tartaric; and the various preparations called baking-powders, custard-powders, egg-powders, &c., are nothing but mixtures of tartaric acid and carbonate of soda, with a little farinaceous matter, the common proportions being 1 part of tartaric acid, 2 of carbonate of soda, and 4 of potato-flour or other dry starch, with a little turmeric powder to give it a rich yellow tint. When this is mixed with flour and wetted, it effervesces, as in the case of a common seidlitz-powder, and so diffuses the carbonic acid through the dough.

Very lately Mr. McDougall has proposed the use of phosphoric acid as a more natural constituent of food than the preceding, and this, with an alkaline carbonate, forms the preparation which is known as phosphatic yeast.

A third process, which is now extensively used in the vesiculation of bread, is that of Dr. Daughlish, and by which the bread called aerated bread is obtained. It consists in the addition of a solution of carbonic acid in water to flour under pressure. The mixture is made in a closed air-tight vessel, in which the dough is well kneaded by machinery, and directly the outlet of the vessel is opened and the pressure thus removed, the gas escapes from the water, as in the case of an uncorked bottle of soda-water, and expands into little bubbles within the substance of the dough. By its expansion, also, it forces itself out of the mixing chamber, and rises into a spongy dough.

In all cases, however, where carbonic acid is generated within the dough by other processes than fermentation, the dough must be baked immediately, or it will fall, and the loaf be heavy. Various contrivances have been suggested for helping the process of kneading, which is laborious, and sometimes not altogether cleanly work. Mr. Stevens' hand machine appears to accomplish this very well. It is in use in the Holborn Union, where about 5,633 lbs. of bread are made every week by one man and two boys; and they contrive to make ninety-six 4-lb. loaves out of every sack of flour (280 lbs.). The materials used on the average of a whole year being as follows:—

PROPORTIONS PER WEEK.

	lbs.	
Flour.....	4,129	Which produce 5,633 lbs. of bread, or 1,408 4-lb. quartern loaves.
Cones.....	140	
Potatoes.....	168	
Salt.....	68	
Malt.....	13	
Hops.....	1½	

The potatoes, the malt and the hops, are for the purpose of making the yeast or ferment for the bread.

But, by whatever process bread is made, it is necessary to observe certain precautions to ensure the production of a good loaf.

1st. The flour should be from sound grain, sufficiently rich in good gluten.

2nd. The yeast should be sweet, and should show a lively action in the sponge.

3rd. The dough should be well kneaded to ensure the thorough diffusion of the gas, and to give toughness to the gluten.

4th. The salt should be used in such proportion as to regulate the fermentation, and give firmness to the gluten, whiteness to the bread, and a good flavour.

5th. The baking should be so managed as to ensure the thorough heating of the loaf to the temperature of at least 212° Fahrenheit, in order that the insoluble starch may be changed by the heat into soluble dex-

trine; and the crust should be light-coloured and thin. This is best effected when loaves are baked singly, as on the Continent, and not in batches, as with us; for in the last case, the top and bottom crusts are thick and hard, and are frequently scorched while the interior of the loaf is doughy and underdone.

Specimens of the different kinds of bread of England and the Continent are upon the table; and you will notice the dark colour of the rye-bread of Europe. I am indebted for these illustrations to the kindness of Mr. Twining, who has liberally placed the valuable collection of foods in his museum, at our disposal. Here, also, is a sample of rye-bread supplied by Mr. William Ray Smee, who, in the interest of the poor, has had it made according to the formula of the Board of Agriculture of 1795. It consists of one part of rice and four parts of rye, ground together and sifted in the usual manner. The meal is then made into dough with yeast; and when fermented is baked in the form of long rolls. The bread is very dark, like all rye-bread, and has a close texture, but it is agreeable to the palate, and is very nutritious. The great recommendation of it is its cheapness, for it can be made at less than a penny a pound, and is therefore a very suitable bread for the poor.

Those flours which do not contain sufficient gluten of the proper quality for fermentation or vesiculation—as barley-meal, oatmeal, Indian-meal, and the flour of peas and lentils, are best cooked by baking them in the form of cakes or biscuits—a practice which is as ancient as the time of the Patriarchs, when, during the Pass-over, they were commanded to eat unleavened bread. The chief food of the common people of Rome was a heavy kind of unleavened bread, like the present polenta of the Italians, which is made of Indian-meal and cheese. As in former times, biscuits and unfermented cakes are made from meal or flour mixed with water and baked; but the texture of the substance is close, and it is not easy of digestion unless it is thoroughly disintegrated. When biscuits are lightened by means of egg and sugar, with a little butter, they are much more digestible; and they are still more so when they are vesiculated and puffed up by means of a small quantity of carbonate of ammonia, as in the case of cracknels and Victoria biscuits.

The so-called farinaceous foods for infants are only baked flour, sometimes sweetened with sugar. The flour must be baked until it acquires a light-brown colour, the temperature being about 400° or 450° Fahrenheit. The granules of starch are then disintegrated and converted into a soluble substance, named dextrin—which, by a further process of cooking or boiling, as in making pap, forms, when properly sweetened, a very excellent food for children. Tops and bottoms owe their value to the same circumstance—viz., that the farinaceous matter, which is so indigestible with infants, is broken up by baking into soluble dextrin.

All varieties of meals and arrowroots are easily cooked by stirring them into boiling water, or boiling milk, until they have the consistency of gruel or hasty pudding, and then boiling for a few minutes. In the case of Indian-meal, rice, split-peas, lentils, and haricots, the boiling should be continued for a considerable time, and the whole grain should be previously steeped in water for many hours; for the starch and cellulose of these vegetables are not digestible unless they are thoroughly disintegrated by cooking. It may be said, indeed, that all vegetables with dense tissues require prolonged boiling to cook them, for cellulose is not

capable of digestion by man unless it is broken up by the action of heat—even starch is likely to pass through the alimentary canal unchanged, if it be not rendered soluble by fermentation or cooking. It is an important question, whether in utilising starchy foods, it may not be advantageous to help their transformation by allowing the grain to germinate to some extent, as in the process of malting, when the starch is changed into sugar. Mr. Lawes has examined this question, and has concluded, from his experiments on stock, that in the case of pigs and bullocks the fattening effect of the grain is not increased; but it may be different with the human stomach, where the transformation power is not nearly so active as with lower animals. Here, in fact, is an example of it:—The food which Liebig recommends for infants is a preparation of malt with wheaten flour and milk, to which a little bicarbonate of potash has been added; and the reputation of it in Germany, as an article of diet for children, is considerable. The preparation is made by mixing 1 oz. of wheaten flour with 10 oz. of milk, and boiling for three or four minutes; then removing it from the fire, and allowing it to cool to about 90°. One ounce of malt-powder previously mixed with 15 grains of bicarbonate of potash, and 2 ozs. of water are then stirred into it, and the vessel being covered, is allowed to stand for an hour and a half, at a temperature of from 100° to 150° Fahrenheit. It is then put once more upon the fire, and gently boiled for a few minutes. Lastly it is carefully strained, to remove any particles of husk, and then it is fit for the child's food. The composition of the food according to Dr. Liebig is as follows:—

Foods.	Plastic matter. ozs.	Carbonaceous matter. ozs.
10 oz. milk.....	0'40	1'00
1 oz. wheat-flour.....	0'14	0'74
1 oz. malt-flour.....	0'07	0'58
	0'61	2'32

The relation of the plastic to the carbonaceous being as 1 to 3·8, which is the right proportion for the food of children.

The effect of the malt-flour is to transform the starch into glucose, and thus the mixture gets thinner and sweeter as it stands; and the bicarbonate of potash is added to facilitate the change, and to neutralise the acid constituents of the flour and malt.

Liebig's extract of malt is another such preparation for a quick assimilation of starchy matters.

Vegetable substances are occasionally fermented, either for the purpose of increasing the relative amount of glutinous matter, or for the purpose of rendering them acid. Potatoes, for example, as well as barley, wheat and rye, leave a residuum after fermentation, which contains more gluten than the original substance, in consequence of the transformation of sugar and starch into alcohol; and although the residuum is coarse, and is hardly suited for human consumption, yet it is an excellent food for cattle; in fact, in Germany, it is often eaten by the poor.

When the process is carried still further, and the mass acquires an acid property in consequence of the formation of acetic, butyric, and lactic acids, various sour preparations are obtained, which are no doubt useful in assisting the digestion of other foods. The ancient Romans had many such fermented substances which were not unlike the sauer-kraut of the Germans. This, as

you know, is made from the leaves of cabbages, gathered generally in autumn, and from which the stem and mid-rib are removed. They are cut up into thin slices, and are placed in a tub or vat, alternately with layers of salt, until the vessel is full. It is then subjected to pressure, and allowed to stand five or six weeks (according to the temperature); the lactic fermentation is thus set up, and the mass becomes sour. It is cooked by stewing it in its own liquor with bacon, pork, or other fat meat; and certain condiments, as dill or caraway, are added to improve its flavour. In Prussia, and in many parts of Germany, there is a similar preparation of fermented beans; and in Holland and the south of Europe cucumbers are fermented. We also have our pickled vegetables in which acetic acid takes the place of lactic acid. All these preparations are no doubt aids to digestion, especially when the fibre of meat is tough, and contains tendon, or hardened cellular tissue. This is especially so with salted meat, and, therefore, a little pickle is always a good and palatable addition to cold boiled beef.

Vegetable substances, as tea, coffee, maté, cocoa, &c., the infusions of which are used as beverages, are prepared for commerce in nearly the same manner. When taken from a tree, and while in a fresh condition, they are allowed to undergo a moderate kind of fermentation, and they are then dried and roasted. In the case of tea, the roasting operation is performed during the process of drying and curling, by heating the leaves upon wire sieves held over a charcoal fire, but cocoa and coffee are roasted in metallic cylinders, which are kept revolving over a clear fire—coffee being roasted until it is partially charred, and has lost from 14 to 20 per cent in weight. By this means the aroma or volatile oil is, in each case, produced; and there is also an empyreumatic change in the astringent acids, the sugar, the gum, and the starch, whereby extractive matters, varying in amount and quality, according to the degree of heat, are formed. Shrader has examined the subject in respect of coffee, and has ascertained that the following are the proportions of the several constituents of raw and roasted coffee:—

	Raw Coffee.	Roasted Coffee.
Peculiar coffee principle . . .	17.58	12.50
Gum and mucilage	3.64	10.42
Fatty matter and resin	0.93	2.08
Extractive	0.62	4.80
Woody tissues and cellulose . . .	66.66	68.75
Mixture, &c.,	10.57	1.45
	100.00	100.00

Infusions of tea and coffee should be made with boiling water, but they should never afterwards be boiled, for the aromatic principle is very volatile, and would be thus lost; besides which a decoction of tea or coffee is disagreeably bitter on account of the solution of the coarse forms of extractive matter. Soft water also extracts these matters, and, therefore appears to give a stronger infusion than moderately hard waters, but it is always at a sacrifice of delicate flavour. Excellent tea is made in London with water of 14 or 15 degrees of original hardness, and of about 5 degrees when boiled. This was a subject of investigation by the Government Chemical Commission (Professors Graham, Miller, and Hofmann), who were appointed in 1851 to inquire into the chemical quality of the water supply of London; and they reported that in their experiments they found

that tea made from the boiled London water of 5 degrees of hardness could not generally be distinguished from tea made with water of 2½ degrees only, although a delicate palate would recognise a slightly increased bitterness without any enhancement of flavour in the latter. It would seem, indeed, that moderately hard water makes the best flavoured tea, provided it is allowed to stand upon the tea sufficiently long. In the case of the Greenwich pensioners the tea was made from water of 24 degrees of hardness before boiling, and 18.6 degrees after; but the infusion was maintained for half an hour by surrounding the vessel with a steam case; and thus an excellently-flavoured tea was obtained. The Commissioners indeed truly remark, that "where any great loss of strength of tea infusion has been observed in passing from a soft water to a harder, it may be probably referred to the circumstance that the mode of infusing it has not been properly adapted to the hard water; and then there is doubtless some waste of tea." Lake waters have been a good deal extolled on account of their softness and supposed fitness for making tea, solely because they happen to produce a deep-coloured solution, which conveys a false notion of strength; but, in reality, flavour is always sacrificed for the mere look of the thing, there being no increase of physiological or dietetical property. The Chinese, who are very good authorities on this subject, never use either very soft or very hard waters, for their rule is to take the waters of a running stream—"best from the hill-side, and next from a river." We may conclude, therefore, that water of from 4 to 7 degrees of hardness after being boiled, is best suited for infusions of tea and coffee; for such water dissolves the aromatic and physiological constituent, without extracting the disagreeable bitter principles. In the case of coffee, in fact, a little acid, as a portion of lemon-juice, improves the flavour, notwithstanding that it adds to the hardness of the infusion. Experimentally, it is found that infusions of tea and coffee are strong enough when the former contains 0.6 per cent of extracted matter, and the latter 3 per cent, so that a moderate-sized cup (5 oz.) should contain about 13 grains of the extract of tea, or 66 grains of coffee. These proportions will be obtained when 263 grains of tea (about 2½ teaspoonfuls), or 2 ozs. of freshly roasted coffee, are infused in a pint of boiling water; and the amounts of the several constituents dissolved are about as follows:—

Constituents.	Tea. grs.	Coffee. grs.
Nitrogenous matters	17.2	44.0
Fatty matter	—	3.0
Gum, sugar, and extractive . . .	31.7	103.2
Mineral matters	9.1	22.8
Total extracted	58.0	173.0

So that tea yields to a pint of fresh water about 22 per cent of its weight, and coffee about 20 per cent. Lehmann found that only 15½ per cent of tea was dissolved by water; whereas Sir Humphrey Davy estimated it at 33½ per cent. No doubt the quality of the water, as well as that of the tea, affects the results, for distilled water will extract from 40 to 44 per cent of black tea, and nearly 50 per cent of green; but for all this, about 22 per cent is a good average.

Tea is generally measured into the tea-pot by the spoonful, and Dr. Edward Smith has made a curious inquiry into the average weights of a spoonful of different kinds of tea. The results are here shown:—

WEIGHT OF A SPOONFUL OF TEA.

Black Teas.		Green Teas.	
	Gr.		Gr.
Oolong.....	39	Hyson.....	66
Congou (inferior).....	52	Twankay.....	70
Flowery Pekoe.....	62	Fine Imperial.....	90
Souchong.....	70	Scented Caper.....	103
Congou (fine).....	87	Fine Gunpowder.....	123

From which it would seem that from three to seven teaspoonfuls of black tea, or from two to four of green, are required for a pint of infusion of the strength already given.

Cocoa is best made by boiling the mixture for a little while, for it nearly always contains a large proportion of starchy matter, which has been added to dilute the rich fat of the cocoa. Indeed cocoa contains so much butter or solid fat (from 48 to 50 per cent), that it is necessary to reduce it with some easily-digestible substance, as starch, lentil powder, carageen moss, Iceland moss, sugar, &c.—hence the various preparations of it called granulated cocoa, soluble cocoa, chocolate, &c., the processes for making which I will briefly describe. When the berry is roasted and is cold, it is passed through a machine called a “kibbling-mill,” which deprives it of its husk, and of the thin skin which surrounds the kernel or nib. If the nibs thus cleaned are ground in proper mills they form the variety of cocoa called flaked cocoa, but if other preparations are to be made, the nibs are ground between heated rollers or otherwise, until they form a smooth paste, when the diluting substances are mixed with it and are thoroughly incorporated. If soluble cocoa is to be made, the diluting material is sugar with some kind of arrow-root, astoules-mois, maranta, curcuma, &c. If chocolate is required, the diluting material is sugar only, with some flavouring agent, as vanilla; and if fancy preparations, as carageen moss cocoa, Iceland moss cocoa, lentil cocoa, &c., are required, then these several substances are incorporated. Granulated cocoa is a preparation of cocoa, with sugar and starch so ground as to form a coarse powder, in which the particles of broken cocoa are covered with a layer of sugar and starch. It is obvious that whenever the mixture consists of starch or other farinaceous substance, the solution of the cocoa preparation must be boiled; but when sugar has been used, as in chocolate, which is the most ancient preparation of it, the combination is such as to require no culinary treatment, or, at most, the action of boiling water or boiling milk.

It is remarkable that, although cocoa is much less used than either tea or coffee, yet it was known in Europe a century before either of the others. As early, indeed, as 1520 it was brought from Mexico, by Columbus, who found it the common beverage of the people; and when Cortes was entertained at the court of the Aztec Emperor, Montezuma, he was treated to a sweet preparation of the cocoa, called *chocolatl*, flavoured with vanilla and other aromatic spices, and served to him in a golden vessel. The Spaniards thus acquired a knowledge of the berry and of its chief preparation, which they kept secret for many years, selling it very profitably as chocolate to the wealthy and luxurious classes of Europe. It was, however, an expensive preparation, and did not come into general use until long after the public coffee-houses of London were established. The earliest notice of it, according to Hewitt, is in Needham's *Mercurius Politicus*, for June, 1659, wherein it is stated that “chocolaté, an excellent West India drink, is sold in Queen's Head Alley,

in Bishopsgate Street, by a Frenchman who did formerly sell it in Gracechurch Street and Clement's Churchyard, being the first man who did sell it in England;” and its virtues are highly extolled. This was about five years after the London coffee-houses had been established—for the first of them is said to have been opened in 1650, by a Levantine named Pascal Rossee, in St. Michael's Alley, Cornhill; and a year after they were opened in Paris and in Holland. In 1660 they were so much frequented, and coffee was so largely drunk, that they were made a source of revenue, a tax of 4d a gallon being levied on all the coffee drunk in them, and three years later they were regularly licensed at the Quarter Sessions like common taverns. In 1668, when Ray, the distinguished naturalist, published his “History of Plants,” he tells us they were as numerous in London as at Cairo; and at last they become so great a nuisance, on account of their political associations, that in 1675 Charles the Second endeavoured to suppress them by proclamation, calling them seminaries of sedition; but the keepers of them were sufficiently powerful to make him revoke the prohibition. The history of these houses would form a curious chapter in politics and literature, for they are associated with the earliest development of free political discussion, and with the greatest names in English literature. Among the oldest of them is the “Grecian,” where Shakespeare and Rare Ben were frequent visitors; and hardly less ancient is “Wills,” where Dryden held forth with pedantic vanity, and where the foundation was laid for that critical acumen which soon became a distinguishing feature in English Literature. In the city, too, there was “Garraway's,” where not only was tea first sold, but where, in Defoe's time, “foreign banguisers,” and even ministers, resorted to drink it. “Robins” and “Jonathans,” and the “Cocoanut Tree,” in St. James Street, were also famous, and had their distinguished followers.

In the treatment of animal food there are several points for consideration. In the first place it is always best to prepare the animal for the shambles by fasting it for a few hours before it is slaughtered, as partially digested food, and the food recently absorbed into the system, quickly pass into a state of putrefactive decomposition and taint the whole carcass; besides which, a day's repose is often necessary to quell the excitement occasioned by the journey or voyage which the animal may have made on its way to a place of slaughter. In the second place, it is proper to remove as much blood from the body as possible at the time of killing, as this also is apt to pass into a state of decay. The regulations of the Jews in this particular are most effectual, and are derived from very ancient statutes in Leviticus, which ordain that no manner of blood, whether it be of fowl or of beast, shall be eaten by man; and with the view of letting as much of it flow away as possible, the practice is to slaughter every animal by cutting its throat with a sharp knife. There are, indeed, the most precise rules for this purpose. In some countries, however, the blood is regarded as a very nutritious part of the animal, and great pains are taken to prevent its escape. Dr. Livingstone says, that many of the South-African tribes kill the beast by thrusting a javelin into the heart, so as to prevent the loss of blood. But in these cases the meat is never kept, but is eaten directly after the animal is slaughtered. A proposition has also been made in this country for killing animals by letting air into the pleural cavities, whereby the lungs collapse, and so cause almost instant death by asphyxia

without loss of blood; but the practice is objectionable, not merely because of the liability of such meat to quick putrefaction, but also because of the difficulty of discovering disease in it.

In the third place, it is proper that the carcass of the animal should be allowed to cool and set thoroughly, before it is packed for conveyance to the market. If this is not properly attended to, it soon decays. It should also be packed loosely, or even exposed freely to the air, as the colouring matter of the blood and muscles continue to absorb oxygen, and to breathe, as it were, for some time after death, and while this goes on decay is arrested.

Lastly, all meat should be kept a little short of decomposition before it is cooked, or even until decomposition has just commenced, as the tissue then becomes loose, and tender, and very digestible.

In the culinary treatment of animal food, the objects are fourfold:—

1st. To coagulate the albumen and blood of the tissues, so as to render the meat agreeable to the sight.

2nd. To develop flavours, and to make the tissue crisp, as well as tender, and therefore more easy of mastication and digestion.

3rd. To secure a certain temperature, and thus to be a means of conveying warmth to the system.

4th. To kill parasites in the tissues of the meat.

Now, as the researches of Dr. Beaumont and others have demonstrated that meat is always rendered more and more indigestible in proportion to the prolonged action of heat, it is highly necessary that the temperature should not be continued beyond the point necessary to accomplish these objects. Liebig says that a temperature of 133° Fahr. will coagulate albumen, and that the red colouring matters of the blood and muscle are coagulated and destroyed at from 158° to 165° (say 170°). He therefore advises that all cooking operations, in respect of meat, should be limited to 170°. His directions are that, in boiling meat, it should be introduced into the vessel when the water is in a state of brisk ebullition, and that the boiling should be kept up for a few minutes. The pot is then to be placed in a warm situation, so that the water is maintained at from 158° to 165°. The effect of this is that the boiling water coagulates the albumen and the tissue upon the surface of the meat, and to a certain depth inwards, and thus forms a crust which does not permit the juice of the meat to flow out, nor the water to penetrate into the meat. The flesh, therefore, retains its savoury constituents, and is not too sodden; but if, on the other hand, the meat be set upon the fire with cold water, and then slowly heated to boiling, the flesh undergoes a loss of soluble and savoury matters, while the soup becomes richer in them. The albumen, in fact, is gradually dissolved from the surface to the centre; the fibre loses, more or less, its quality of shortness or tenderness, and becomes hard and tough. The thinner the piece of flesh is, the greater is its loss of savoury constituents.

This explains the well-known observation that that mode of boiling which yields the best soup gives the driest, toughest, and most vapid meat; and that, in order to obtain well-flavoured and eatable meat, we must relinquish the idea of making good soup from it.

If finely-chopped flesh be slowly heated to boiling with an equal weight of water, and be kept boiling for a few minutes, then strained and pressed, we obtain the very strongest and best flavoured soup which can be made from flesh. When the boiling is longer contin-

ued, some little additional organic matter is dissolved, but the flavour and other properties of the soup are thereby in no degree increased or improved. By the action of the heat on the fibres of meat, a certain amount of water or juice is always expelled from them; whence it happens that the flesh loses weight by boiling, even when immersed in water (as much sometimes as 24 per cent of the weight of raw flesh). In larger masses this loss is not so great.

Even in roasting meat the heat must be strongest at first, and it may then be much reduced. The juice which, as in boiling, flows out, evaporates, in careful roasting, from the surface of the meat, and gives to it the dark brown colour, the lustre, and the strong aromatic taste of roast meat. It is doubtful, however, whether the heat of 170° is sufficiently high to ensure the destruction of the parasites of meat, and therefore I would advise that the temperature should be as nearly as possible to that of boiling water (212°).

Of the four methods of cooking which are commonly practised in this country—viz., boiling, baking, roasting, and frying, the former is undoubtedly the most economical, and produces the most digestible food, but the flavour of the meat is not well developed, and it is quite unsuited for many descriptions of meat; the flesh of young animals, for example, consisting of an undue proportion of albumen and gelatine in the tissues, will boil away to a large extent, and so will loose fatty tissue, like that of American bacon; and, indeed, unless the process is well managed, there will always be considerable loss, as I have just stated, from the escape of albumen, saline matter, and the alkaloids of the meat into the water, amounting sometimes to from 16 to 24 per cent of the weight of the joint; and that these are valuable constituents of flesh is proved by the experiments of the French Academicians, who found that when a dog was fed daily upon half a pound of boiled flesh which had been previously soaked in water and pressed, it quickly lost weight—as much, indeed, as one-fourth of its entire weight in forty-three days; and in fifty-five days the emaciation was extreme. Of course these observations do not apply when the liquor in which the meat is boiled is eaten with it, as in the case of hashes, stews, &c.

Dr. Pereira states that at the Wapping Workhouse, where mutton (chiefly fore-quarters) and beef (consisting of the brisket, thick and thin flanks, leg of mutton pieces, and clods—all free from bone) were boiled, the average loss in weight was only about 17½ per cent; but this is under the common proportion, and shows that the meat was from old and lean animals. The ordinary loss of weight in cooking is about as follows in every 100 parts:—

	Boiling.	Baking.	Roasting.
Beef generally.....	20	29	31
Mutton generally.....	20	31	35
Legs of mutton.....	20	32	33
Shoulders of mutton.....	24	32	34
Loins of mutton.....	30	33	36
Necks of ditto.....	25	32	34
Average of all.....	23	31	34

But, although the loss of weight in baking and roasting is greater than in boiling, yet it is chiefly from evaporation and from the melting of the fat. Flavours also are developed which give a pleasant relish to the meat; but there are many disadvantages to these methods of cooking, as that the surface of the joint is often over-

done when the interior is almost raw; and that the action of the heat on the superficial fat frequently produces acrid compounds (consisting of acrolein and fatty acids) which are very distressing to a sensitive stomach. This is always the case when meat is fried or grilled, and is thus subjected to a temperature of 600° or more; in fact, all baked and roasted fatty foods are apt, on this account, to disagree with delicate stomachs; and it is often remarked that, although bread and butter, boiled puddings, boiled fish, or boiled poultry can be eaten freely without discomfort, yet toast and butter, or meat pies and pastry, or fried fish, or roasted fowl, will disagree with the stomach. The practice of covering poultry and game with lard, or oiled paper, or thin dough, or even with clay (feathers and all, as is the Indian custom), and then roasting, is no doubt advantageous, as it modifies the temperature and prevents the formation of acrid fatty compounds. It was by some such device as this that Aristoxenes was able to serve up a pig apparently boiled on one side and roasted on the other—the savoury crackling being suited for stronger stomachs, while the more delicate side of it was best adapted for weaker digestions.

In deciding, however, on the proper method of cooking a joint, regard must always be had for the kind of flavour that is to be developed. Shoulders of mutton and fresh beef are rarely boiled, because of their insipidity. The same is the case with game and poultry, for the barn-door fowl and turkey are nearly the only examples of the latter which can be boiled, and there are no such examples among the former. What should we think of a boiled pheasant? A story is told by a writer in the *Society's Journal*, of a poacher who wished to seduce a bumpkin new poacher by a practical illustration of the fine flavour of game, and calling at his cottage one day, he left for him a hare, warm from the chase, telling him to cook it, and to try if it wasn't a nice dinner for nothing. A week after he called again, and asked him how he liked his dinner. "Didn't loike it at all," exclaimed the recipient. "Well, man," says the poacher, "how did e cook en?" "Why, biled en in tarmuts, to be sure." I won't attempt to describe the disgust of the poacher. The same is the case with venison, although it may be boiled, especially when it is rather high, for about half the time necessary for cooking it, yet it must be roasted, in order to develop its flavour. Hunters in the wild prairies of America are accustomed to cook the flesh of the deer by brittling it in the following manner:—They strip off the long muscles from each side of the spine, both above and below, and tie them up in a roll, after well smearing them with oil or fat; they then roast them, and baste them perseveringly with oil. If opportunity permits, they sprinkle them with lemon-juice, before they are oiled and made up into a roll. The flavour of roasted meat and its grateful effect on the sense of smell must have been recognised in very early times, for burnt offerings are frequently spoken of by Moses as "a sweet savour unto the Lord," and particular accounts are given of the manner in which these offerings of the lamb and the kid, &c., were to be made acceptable, not merely to the Lord, but also to Aaron and his sons, who were to eat of them. How far back in history the flavour of roast pig was eulogised I know not, but it is immortalised in the essay of Charles Lamb. As for the process of baking meat, it is not nearly so refined as that of roasting, although it has one advantage, in the circumstance that the temperature can be more easily regulated than with roasting.

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In making soup, the object is to extract, as completely as possible, all the soluble constituents of the meat or bone, and when the latter is used it should be chopped or broken into small pieces, and boiled for a considerable time—not less than nine or ten hours. Shin-bones will then yield about 19 per cent of their weight of fat and gelatine—the soup being, according to Dr. E. Smith, very nutritious, so that 6 lbs. of bones will produce a soup that contains the nutritive power of 2 lbs. of meat as far as carbon is concerned, and of 1 lb. of meat in respect of nitrogen; but although this may be so as regards the actual quantities of carbonaceous and nitrogenous matters present, yet it is very doubtful whether they are equally nutritious, for in the renowned experiments of the French Gelatine Commission it was found that the soup or jelly from boiled bones would not support the life of dogs, although raw bones, in like proportion, would.

Ox-tail soup is much richer than that from bones alone, as it contains the saline and other constituents of flesh. It is now a favourite and rather expensive soup, although at one time it was the humble fare, and almost the only nitrogenous food of the poor Protestant French refugees of Clerkenwell. Prior to the year 1689, or thereabout, the butchers of London left the tails attached to the hides, which were sent to the tanners of Bermondsey, but the poor French refugees, in their extremity of want, bought the tails for a mere trifle, and converted them into soup, which was soon found to be of excellent quality.

Soup made from meat should be obtained in the way already described—that is, a given weight of meat, chopped fine, should be allowed to macerate in its own weight of cold water, and should then be gradually heated to the boiling-point, after which it should be strained and pressed. In this way about 3 per cent of the nutritious matter of the meat is dissolved, besides the saline constituents. If the soup be simmered with the meat for some hours, a larger proportion of organic matter, chiefly gelatine, will be dissolved; and a good soup thus made from shin of beef will contain about 600 grains of solid matter in a pint, and of this about 39 grains are saline.

Lean meat contains about 25 per cent of solid matter, the rest being water, and of this from seven to ten parts are soluble in cold water; rather more than half of this is albumen and miochrome (colouring matter), which are coagulated by heat, and thus, if the cold solution of flesh be boiled, it contains only from 3 to 4 per cent of the meat; and when evaporated to dryness it constitutes the *extractum carnis* of Liebig. It can hardly be said, however, that the nutritive power of this extract is very great, for its chief constituents are certain acids, lactic and inosic, with enosite, creatine, creatinine, and an indefinite colloidal organic substance of a brown colour and syrupy consistence; besides which it contains the soluble saline matters of the meat, as phosphate and chloride of potassium, with a little chloride of sodium. Analyses of this extract, as found in commerce, have furnished from 41 to 60 per cent of water, from 22 to 41 per cent of organic matter, and from 8 to 16 per cent of saline matter. The extract is always acid; and it should be of a pale yellowish brown colour, with an agreeable meat-like odour and taste. It should also be perfectly soluble in cold water, and should not contain albumen, fat, or gelatine.

False views have been entertained of the nutritive power of this extract, for, as 1 lb. of it represents the soluble constituents of from 30 to 34 lbs. of lean meat,

or from 45 to 48 lbs. of ordinary butchers' meat, it has been assumed that its nutritive power is in this proportion; but Liebig has taken care to correct this error, by showing that the extract, when properly prepared, merely represents the soup or beef-tea obtainable from that quantity of meat; and, as it is deficient of albumen, it must be conjoined to substances which are rich in this material, as beans and peas. No doubt the physiological action of the extract is due to the alkaloids which it contains; and as the former of these are of tea and coffee (theine or caffeine) in their effects on the body, it must be concluded that extract of meat is more of a vital restorative than a nutritious food. It is from this point of view that Parmentier, Proust, and even Liebig himself, are disposed to regard the physiological effects of the preparations. "In the supplies of a body of troops," says Parmentier, "extract of meat would offer to the severely wounded soldier a means of invigoration which, with a little wine, would instantly restore his powers, exhausted by great loss of blood, and enable him to bear being transported to the nearest field hospital;" and, in almost the same language, Proust remarks that "we cannot imagine a more fortunate preparation under these circumstances; for what more invigorating remedy, what more powerfully-acting panacea than a portion of genuine extract of meat dissolved in a glass of noble wine?"

As in the case of soup and beef-tea, its nutritive power must be assisted by vegetables and other substances which are rich in nitrogenous matters. Conjoined, therefore, with wheaten flour, with peas or lentils, or even with the gluten obtained in the manufacture of starch by Durand's process, it may be made to have the nutritive power of meat. Already there is a preparation of it by Messrs. Peak, Frean, and Co., in which the extract is mixed with baked flour and pressed into small biscuits; indeed, as far back as the year 1851, Mr. Borden, jun., obtained a patent for combining extract of meat with flour, farina, or meal, and baking it in the form of biscuits. In this manner, by using the extract of 5 lbs. of meat with 1 lb. of flour, he produced biscuits which contained 32 per cent of nitrogenous matter; and 1 oz. of the biscuit grated into a pint of water, then boiled and flavoured, made a good soup. In the case of Liebig's extract of meat, 1 lb. of the preparation is sufficient, with the usual rations of potatoes and other vegetables, to make soup for 130 men; and a strong broth is made by dissolving a teaspoonful of it (about 150 grains) in half a pint of boiling water, and flavouring with salt and pepper.

A still more nutritious broth, containing the albumen of the meat, is obtained by infusing a third of a pound of minced meat in 14 ozs. of cold soft water, to which a few drops (4 or 5) of muriatic acid, and a little salt (from 10 to 18 grains) have been added. After digesting for an hour or so, it should be strained through a sieve, and the residue washed with 5 ozs. of water and pressed.

The mixed liquids thus obtained will furnish about a pint of cold extract of meat, containing the whole of the soluble constituents of the meat (albumen, creatine, creatinine, &c.), and it may be drunk cold or slightly warmed—the temperature not being raised above 100° Fahr., for fear of coagulating the albumen.

There are many questions connected with the economy of cooking which I have not time to discuss, but I may state that this Society has done good service for the community in obtaining valuable information as to the simplest and cheapest apparatus for the purpose.

Foremost among them is the cooking-pot of Captain Warren. It is a sort of double saucepan, and is easily made by fitting a small-covered saucepan into a larger one. The inner vessel contains the joint or other thing to be cooked, and the outer one has a little water in it, so that the temperature in cooking can never exceed 212°. By this means the joint is cooked in its own vapour without coming into contact with water or steam, and thus it cannot lose its soluble constituents; and if it be desired to improve the flavour of the joint just cooked, it may be afterwards roasted for a short time before the fire. The loss in weight under these circumstances is not nearly so great as in the common way of cooking, and the flavour and tenderness of the meat are considerably increased; besides which, there is the certainty of cooking the joint equally throughout, without over-dressing it. Moreover, by the adaptation of a steamer to the outer vessel, vegetables may be also cooked at the same time. When the meat is boiled by this process, there is little or no loss of weight, and even when it is afterwards roasted, for the purpose of improving its flavour, the loss is not nearly so great as when a joint is roasted in the ordinary way. In one experiment it was found that 15 lbs. of meat roasted in the usual manner, in the kitchen of the Cambridge Barracks, lost 4 lbs. 4 ozs. in weight, whereas the meat cooked in Captain Warren's pot, and then roasted, lost only 2 lbs. 15 ozs., so that there was a gain of 1 lb. 5 ozs.

Another apparatus of very great ingenuity is a cooking-pot from Switzerland, where the saucepan containing the joint and a little water is, after boiling for a short time, placed in a box lined with felt, and thus left for an hour or two to cook, the conducting power of the felt being so bad that the heat is retained in the most perfect manner. The apparatus is not only economical, but it is also excellently well suited for picnic parties or for soldiers on the march, who may thus secure a hot dinner, cooked while on the journey.

The cooking appliances of the poor are very imperfect, and hence they resort to the cook-shops of their neighbourhood; but even then their meals are scanty and wretchedly cooked. In the poor districts of London three-halfpence is the usual expenditure for a dinner by children—a penny going in pudding, and the halfpenny in potatoes. If they pay twopence they are allowed to sit down, and have a little gravy with it. Everybody has heard how the poor of Paris dine *à la squirt*, where the tin soup basins are nailed to the table, and where the attendant Leonoras draw up the seething soup from a hidden cauldron by means of a huge syringe, from which it is driven out into the customer's basin. The price of the meal (4 sous) must be instantly paid down, or the callous handmaid sucks up the soup again into the monster squirt. Scenes like this, and even worse than this, in the abodes of the poor, have urged philanthropists to seek a better means of supplying their wants, without trespassing upon the dangerous ground of charity. In Paris, an enterprising widow (Madame Robert) conceived the idea of giving a poor man a good dinner for twopence. Her daily bill of fare was cabbage-soup, a slice of bouilli (beef), a piece of bread, and a glass of wine; and thus, in the neighbourhood of the Marché des Innocents, did she daily provide for some 6,000 workmen, who took their dinners in the open air, but sheltered from the weather; and she gained a farthing by each guest. In this country a like benevolence has set on foot, with more or less success, in different places, *restaurants* for the poor.

In Glasgow, for example, the working-class dining-rooms, which are far above the rude accommodation of Madame Robert, are established to provide a substantial dinner for 4d. or 5d. Long ago the special correspondent of the *Daily Telegraph*, in writing about them, said that he obtained a capital dinner of good pea-soup, boiled beef, 10 ozs. of potatoes, and pudding—more than he could eat—for the sum of 5½d.; and a writer in the *Times* also stated that for 4½d. he had a pint basin of pea-soup, a plate of hot minced collops, a plate of potatoes, and 8 ozs. of bread; while his companion had, for the same sum, a pint basin of broth, a plate of cold beef, a plate of potatoes, and a slice of plum-pudding, all excellent in their quality, and well cooked. The practice in these places is to provide daily a variety of hot foods—as soup, broth, potatoes, rice, cabbage, pudding, tea and coffee—besides bread and butter, cold pressed beef and ham; and every ration, except meat, is so apportioned as to be sold at the uniform price of a penny. The meat costs three-halfpence; and, with the view of clearing off the remainder of the soup after the proper dinner hour, so that a fresh quantity may be made every day, it is the practice to sell the soup and broth, at half price, from six o'clock to eight o'clock in the evening, and then to give the remainder away. All the articles are of the best quality, and are well cooked. They are bought by contract at wholesale prices; and, although they are sold so cheaply, yet they yield a small profit, and so give the system the stability of a commercial enterprise.

Very recently, too, Mr. Riddle has proposed, in a paper which was read before this Society, that arrangements might be made for cooking dinners on a large scale, and sending them out to the houses of the poor. He proposes to prepare, daily, good rations of roasted, baked, and boiled meat, with vegetables, and to send them out in 2 lb., 4 lb., or 6 lb. tin canisters, all ready for immediate use, and kept warm in little compartments of a properly-constructed cart. There would be no difficulty about this, and the meat might be delivered in excellent condition and with great punctuality. None but those who are acquainted with the utter helplessness of the poor in the matter of cooking food, or who know the difficulties of even better classes of persons in this matter, can form any notion of the value of such a proposition; and I should be glad to see it realized.

(To be continued.)

SPECTRUM OBSERVATIONS

CONNECTED WITH

THE RECENT ECLIPSE OF THE SUN.

THE French Minister of Public Instruction has received the following report from M. G. RAYET, who examined the protuberances spectroscopically during the total eclipse of the sun of August 18th, 1868, on the peninsula of Malacca:—



"The apparatus which I used at Wah-Tonne for the optical examination of the light of the protuberances, consisted of a telescope with a silvered glass mirror 20

centimetres in diameter, mounted equatorially for the latitude of the station, and of a direct vision spectro-scope. The latter instrument, formed of three very dispersing prisms, was arranged of short length and to give much light.

"*Spectrum of the Horns.*—The slit of the spectro-scope having been arranged so as to cut at right angles the image of the narrow luminous arc which would remain some seconds before total obscurity, I first examined the light from the extremity of the horns. On the ground of a spectrum with very sharp black lines formed by the diffused atmospheric light, was seen a much more luminous band, which was the spectrum of the light emitted by the extremity of the horn. Whatever was the width of this part, nothing particular could be noticed in it; the rays had an appearance in respect to width and intensity identical with those of the ordinary solar spectrum. The observation of the horns was interrupted some seconds before totality, in order to remove the diaphragms from the telescope, to slightly open the slit of the spectro-scope, and thus be prepared to examine the protuberances.

"*Spectrum of the Protuberances.*—At the instant of total obscurity, the slit of the spectro-scope having been brought on to the image of the long protuberance, which became visible on the eastern edge of the sun, I immediately saw a series of nine brilliant lines, which, by their arrangement in the field, their relative distance, their colour, and their general effect as a whole, appeared to be related to the principal lines of the solar spectrum—B, D, E, F, an unknown line, F, and two lines of the group, G. These lines possessed great brilliancy, and appeared strongly relieved from the ashy grey very pale ground.

"The protuberances are therefore jets of incandescent gaseous matter, the flames of a chemical phenomenon of extreme energy. It may also be remarked that the light of the corona is very faint in comparison with that of the protuberances; for whilst the light of the latter gave a very vivid spectrum, the corona, in spite of the rather large opening of the slit, did not give any appreciably coloured spectrum.

"During the preceding observations, the slit of the spectro-scope was parallel to the principal length of the protuberance. Thus the luminous lines were seen in the apparatus of a length in proportion to the height of the protuberance; the slit having been turned 90° round, the rays appeared reduced to the appearance of brilliant points corresponding to the slight width of the luminous horn; no error of observation is therefore possible, and the brilliant lines actually represent the spectrum of the light of the protuberances.

"The spectro-scope being in the first position (the slit parallel to the length of the protuberance) the very brilliant lines corresponding to D, E, and F, were prolonged beyond the mean length, by a very feeble luminous tract, the spectrum presenting the appearance given in the accompanying drawing. A certain portion of the incandescent gaseous light which forms the

protuberances therefore spreads into the solar atmosphere beyond the limits which the eye in general assigns to these expansions.

"The examination of this first protuberance being finished, I directed the slit on to the large luminous region which was at the west of the sun. This time, also, the spectrum was seen to consist of brilliant lines arranged as in the first case, with the exception of there being only one violet line. Therefore all the protuberances do not appear to emit identical light."

On the 24th of October, the Minister of Public Instruction received the following letter, addressed to him by M. JANSSEN, who was commissioned to examine the phenomena of the eclipse:—

"Cocanada, September 19, 1868.

"Sir,—I have this moment come from Guntoor, in the interior, where I observed with a fine sky the great eclipse of the 18th of August. A messenger starting for Bombay, I take the opportunity of sending quickly to you my views, reserving a more detailed account for the next steamer. The hospitality of the English has been worthy of its reputation. Lord Napier had me taken from Madras to Masulipatam in a steam-boat belonging to the state; another steam-boat has been placed at my disposal in the Godavery, and a sub-collector, Mr. Graham, was attached to my mission to remove all the difficulties which I might encounter in the interior, chiefly on account of the quantity of luggage which will follow me. The station of Guntoor is undoubtedly most favorable; the sky was beautiful, especially during the totality, and my powerful telescopes, of nearly three metres of focus, have enabled me to make an analytical study of all the phenomena of the eclipse. Immediately after the totality two magnificent protuberances made their appearance; one of them of more than three minutes in height shone with a splendour which it is difficult to imagine. An analysis of its light showed me directly that it was formed by an immense column of incandescent gas, principally composed of hydrogen. The analysis of the regions surrounding the sun where M. Kirchhoff places the solar atmosphere has not given me results conformable to the theory prescribed by this illustrious physicist. These results, it appears to me, should lead to a knowledge of the real constitution of the solar spectrum. But the most important result of these observations is the discovery of a method of which the principle was conceived during the eclipse itself, and which will allow of the study of protuberances and of the regions surrounding the sun at all times, without its being necessary to have recourse to the interposition of an opaque body before the sun's disc. This method is founded upon the spectral properties of the light of the protuberances—light which resolves itself into a small number of very luminous pencils corresponding to the obscure rays of the solar spectrum. The day after the eclipse the method was applied with success. I was enabled to assist at a new eclipse, as it were, which lasted throughout the entire day. The old protuberances were greatly modified; there remained scarcely any traces of the great protuberance, and the distribution of the gaseous matter was very different. From this day to the 4th of September I have constantly studied the sun from this point of view. I have made pictures of the protuberances, which demonstrate with what rapidity (often in some minutes) these immense gaseous masses are broken up and displaced. In conclusion, during this period, which has been like an eclipse of seventeen days, I have collected a great number of facts on the physical constitution of the sun.—(Signed) JANSSEN."

In our last number we gave an extract from the

Photographic News, animadverting on the mismanagement which had caused the English attempts to photograph the eclipse to be a comparative failure. It is some consolation to find that the German photographic expedition was eminently successful, and the following graphic account, from the pen of Dr. Vogel, the photographer in chief, will show how well success was earned:—

"At the day of the eclipse we rose at four o'clock in the morning. It was the task of the North German expedition to make a photographic view of the eclipse during its totality. For this purpose we had a long telescope with a lens of 6 inches, without difference of focus, and with a focal distance of 6 feet. This lens, constructed by Steinheil, afforded a solar image of three quarters of an inch in diameter, which was taken upon a photographic plate by means of an ordinary sliding chest for two images.

"The totality of the eclipse at Aden was about three minutes long (in India five minutes); nevertheless, we had chosen Aden for our station because there were already photographic observers in India, and because the totality appeared at Aden about an hour earlier than in India. Therefore a comparison of the different results would enable us to decide the question, if the protuberances appearing at a total eclipse of the sun were changing in the course of time or not.

"Our task was now to get within these three minutes as many views of the phenomenon as possible. For this purpose we had previously exercised ourselves in the employment of the photographic telescope, like artillerymen with their guns.

"Dr. Fritsche prepared the plates in the first tent, Dr. Zenker put the sliding chests into the telescope, Dr. Thiell exposed, and I myself developed in the second tent.

"We stated that it was possible in this way to get six images (three plates of two images) during three minutes.

"When the decisive moment was fast advancing, the sky, hitherto covered with clouds, showed some openings, through which the sun, already covered partially by the moon, was to be seen. The landscape around was illuminated by the strangest light, a medium between moon and sun light.

"The chemical strength of light was exceedingly weak. A proof plate gave a wholly exposed image of the cloud after fifteen seconds. The sun crescent became smaller and smaller, and the opening in the clouds seemed to increase.

"The last minutes before the totality (which began at twenty minutes past six o'clock) went rapidly away. Dr. Fritsche and myself crept into the tents, where we remained, consequently we have seen nothing of the totality. Our work began; we exposed the first plate five and ten seconds, in order to know what was the just time.

"Muhammed, our black servant, brought the first attempt into my tent. I poured the iron developer over the plate, eager to know what was to come. At this moment my light was extinguished. I called for light, but nobody heard me, as all were about their task. I stretched my right hand out of the tent, holding the chest in the left, and happily caught a small oil lamp, which I had previously prepared. And now I saw the image of the sun appearing on the plate. The dark margin of the sun was surrounded by a series of peculiar elevations, the other side showed a strange hook; the phenomenon being exactly the same in both

VIEWS. My joy was great, but there was no time for enjoyment. I soon received the second, and, after another minute, the third plate. 'The sun is coming forth!' exclaimed Dr. Zenker. The totality was over. All this seemed to have been done in a moment.

"When I developed the second plate I perceived only very weak traces of an image. The clouds had veiled the sun at the very moment of the exposure. The third plate gave two brilliant views, with protuberances at the lower margin. Glad to have reached so much, we washed, fixed, and varnished the plates, and immediately took some copies on glass, which were to be dispatched to Europe separately."

On the day of the eclipse Major TENNANT wrote from Guntoor to the Astronomer Royal as follows:—

"This morning was very promising, and if it had followed the course of its predecessor we should have had a magnificent clear sky, but it clouded over the east with thin cumulostrati, which, while hardly stopping vision, interfere very much with the photographic energy; and the result was that every negative was under-exposed, and we have little more than very dense marks showing the protuberances. The six plates arranged for were duly exposed, but the heat so concentrated the nitrate of silver solution that, besides showing but faint traces of any corona, they are all covered with spots. Still we may make something of them, and will try.

"Captain Branfill reports the protuberances unpolarised, and the corona strongly polarised everywhere in a plane passing through the centre of the sun.

"Complementarily, I have to report a continuous spectrum from the corona, and one of bright lines from the prominence I examined. I am, I believe, safe in saying that three of the lines in the spectrum of the protuberances correspond to c, d, and b. I saw a line in the green near f, but I had lost so much time in finding the protuberance (owing to the finder having changed its adjustment since last night) that I lost it in the sunlight before measuring it, and I believe I saw traces of a line in the blue near g, but to see them clearly involves a very large change in the focus of the telescope, which was out of the question then.

"I conclude that my result is that the atmosphere of the sun is mainly of non-luminous (or faintly luminous) gas at a short distance from the limb of the sun. It may have had faintly luminous lines, but I had to open the jaws a good deal to get what I could see at first, and, consequently, the lines would be diffused somewhat; still I think I should have seen them. The prominence I examined was a very high narrow one, almost, to my eye, like a bit of the sun through a chink in brightness and colour (I could see no tinge of colour), and somewhat zigzagged like a flash of lightning. It must have been three minutes high, for it was on the preceding side of the sun near the vertex, and was a marked object, both in the last photo-plate just before the sun reappeared, and to the eye.

"Captain Branfill saw the prominences coloured, as did two other gentlemen; but one in my observatory (like myself) only saw it white. I should, however, say that for long I never saw α Orionis markedly red, nor Antares, and I may not catch red soon, though I cannot conceive this being so.

"In conclusion, I may note that the darkness was very slight, and the colour not half so gloomy as in the eclipse of 1857, which was partial at Delhi, where I was then."

Five days after writing the above, Major Tennant wrote to Dr. Warren De la Rue as follows:—

"I did myself the pleasure of sending Mr. Airy a report, such as I could hurriedly make, upon the 18th, of what we had seen and done. Since then we have been enlarging the photographs, and I am very well satisfied. The clouds reduced the actinism very much and very unequally, but that has shown new things to me. 1st. There is very little corona. 2nd. The cloudy structure of prominences is very marked. But the most remarkable thing is a great horn, which seems to have been 3' 20" nearly high. I have, as I told Mr. Airy, clearly seen in its spectrum, c, d, and b, and I believe I saw f, but did not identify it. Now this shows both in Nos. 1 and 3 (photographs) as a ribbon of light, coiled spirally round a semi-transparent centre. It is very beautiful, and marked in 3, which was taken two minutes after the (commencement of) totality, and I am doing my best to keep this feature (to retain this feature) in the copies. No. 1 was taken apparently before the last of the sun went. Phillips (one of his assistants) says it was, and there is a spot of fog such as would be the result. There is a fine line of light seen through all this fog much brighter than the corona. This, too, I am keeping on enlarging. We have got six enlarged positives about 2½ inches in diameter from each negative. Every one of these shows the same remarkable spiral structure in the great horn. I find there are traces in a drawing which Dr. Janssen got made of that prominence (mentioned in the first part of his letters as invisible to the eye) of which I spoke. The positive copies I will enlarge to nine inches."

The following communication was addressed by Lieut. JOHN HERSCHEL, R.E., to Mr. Huggins, F.R.S., and is dated Belgaum, Aug. 25th:—

"The week preceding the event had quite prepared me for disappointment. There seems to be an annual cloudy and rainy season at Jamkandi, which lasts about a fortnight, and was said to be somewhat later and more marked than usual this year. The morning broke, however, as usual, clear, but the driving monsoon clouds soon showed the kind of sky we were to expect. About a quarter of a minute before totality a thick cloud obscured the sun. I had placed the slit (of the spectroscope) so as to cross the crescent at about the vanishing point of the limb, and was watching the narrow solar spectrum grow rapidly narrower. You may conceive the state of nervous tension at this moment. Whatever the corona was competent to show must in a few seconds have been revealed—unless, indeed, it should so happen that a prominence should be situated at that precise spot, in which case the double spectrum would be presented. But the solar spectrum faded out while it had still appreciable width, and I knew a cloud was the cause. I went to the finder, removed the dark glass, and waited—in that fever of philosophical impatience which recognises the futility of irritation, even while it chafes under the knowledge of fleeting seconds—how long I cannot say, perhaps half a minute. I can well recall the kind of frenzied temptation to turn screws and look somewhere else, checked by the calm ticking of the clock telling of a firm hold of the right place, cloud or no cloud. Soon the cloud hurried over, following the moon's direction, and therefore revealing first the upper limb, with its radiating, and, as I fancied, scintillating corona, and then the lower limb. Instantly I marked a prominence near the needle point in the finder. A rapid turn of the tangent screw covered it with the point of the needle. Those few seconds of unveiling were practically all that I saw of the eclipse as a spectator. With the exception

of a hurried glance into the finder at a later period to watch for another break, I was the whole time engaged at the spectroscope. I have not the remotest idea from actual experience of the external phenomena which were present to the thousands of upturned faces whose voices I heard outside. I might easily have lifted the curtain and looked out while the clouds were obstructing. That I did not do so is only to be explained by the absence of mind, as regarded all else, produced by the concentration of attention on the problem before me. To return: the instant the prominence was under the needle point I returned to the spectroscope. A single glance solved the problem in great measure. Three vivid lines—red, orange, blue! No others, no trace of a continuous spectrum. I think I was a little excited about this time, for I shouted quite unnecessarily to my recorder, 'Red, green, yellow,' quite conscious of the fact that I meant orange and blue. I lost no time in applying myself to measurement. And here I hesitate; I have no idea how those five minutes passed so quickly. Clouds were evidently passing continually, for the lines were only visible occasionally. The red must have been less vivid than the orange, for after a short attempt to measure it I passed on to secure the orange, and, succeeding to my satisfaction, tried for the blue line. Here I was less successful. The glimpses of light were rarer and feebler, the line itself growing shorter and further from the cross. I did, however, place the cross very near the true position, and got a reading just as the re-illumination of the field of view informed me that the sun had reappeared on the other limb. I consider there can be no question that the orange line was identical with δ (sodium), so far, at least, as the instrument is competent to establish an identity. I also consider that the identity of the blue line with r (hydrogen) is not established; on the contrary, I believe the former is less refracted than r , but not much. With respect to the red line, I hesitate much in assigning an approximate place. It might have been near c (hydrogen). I doubt its being so far as n , but there would be its limits. The corona may have projected a spectrum of some kind, but I saw none. I therefore conclude it was a faint solar spectrum, a conclusion in accordance with other characteristics of the phenomenon, but especially with the (flickering?) radiating appearance, and with the satisfactory determination by Lieutenant W. M. Campbell, R.E., of the conditions of polarisation obtaining in the corona. At present it is sufficient to state that these observations leave no doubt that the light of the corona is polarised in places passing through the sun's centre. I have had no communication with any other observers since the event. I am curious to learn how far our results will corroborate each other."

Captain C. T. HART, R.E., who observed the eclipse at Bejapoor with a hand spectroscope, has forwarded a communication to the President of the Royal Society, from which we extract the following:—

"I may state at once that I observed the spectra of two red flames close to each other, and in their spectra two broad bright bands quite sharply defined, one rose-madder and the other light golden. These spectra were soon lost in the spectrum of the moon's edge just before emergence, which had also two well defined bright bands (one green and one indigo) about a quarter the width of the bands in the spectra of the flames, this spectrum being again soon lost in the bright sunlight.

"While the obscuration was increasing, Captain Tanner, during the few peeps we got at the eclipse, made drawings of the sun's spots, and sketched the mountains on the moon's edge, of which there were two plainly visible even with my small theodolite. The darkness increased very slowly till just before totality, when the increase was very rapid and sudden, and a general spontaneous exclamation 'Oh!' from all of us gave Mr. Kero Laxuman the time of beginning of totality, which he recorded as 9b. 1m. 49s. The eclipse was at that time completely shut out from our view by the clouds—nimbi low down being carried past by the high wind; we therefore felt at leisure to make our remarks on the degree of the darkness, which we were surprised to find so far from total. We could easily write, read our writing, and read the seconds of our watches without the aid of artificial light. We were all lamenting our misfortune in not being able to observe the eclipse, and had given up all hope of witnessing the phenomena we had come so far to see, and Captain Tanner had just noticed the faint reappearance of light in the west, when, contrary to all expectation, and to our intense satisfaction, a sudden opening in the nimbi showed us the eclipse through the cirrocumuli. We were each at our telescopes in an instant. I immediately saw through the naked telescope of the small theodolite that red flames were visible, and at once pointed the spectroscope, using the theodolite telescope as a rest. Very fortunately I directed the spectroscope with its 'refracting edge' tangent to the moon where two red flames were protruding separate from each other by a small interval; so that their spectra, which were identical, were extended over the dark background of the moon's disc, and stood out in most marked and brilliant contrast with the feeble but continuous spectrum of the corona; and in their spectrum there were the two broad bright bands I have above described. Most fortunately also, these red flames were on the part of the sun which first reappeared; so that just before or just at emergence there appeared at the very part I was intently observing one brilliant wide spectrum with the green and indigo bands before described, remaining visible for an interval just long enough to enable me to make quite sure of the position of the bands, which were then obliterated by the bright light of the sun. Of course, observing with the spectroscope alone it would have been impossible to say whether the spectrum with the green and indigo bands appeared just before or just after emergence; but I think it must have been just before, because Captain Tanner called out when totality was over; and I immediately remarked that I thought he was rather late, but he was quite confident about the accuracy of his observation. What struck me as being very remarkable was the circumstance that though the light of the red flames was to the naked eye so feeble as to be outshone to extinction by that of the corona, nevertheless, when viewed with the spectroscope, the spectrum of the corona was very weak, and that of the flames remarkably brilliant. On the first glimpse of the eclipse, before looking through the telescope, the corona appeared so bright that it gave me the momentary impression (as it did to Captain Tanner) of its being an annular eclipse. We are divided in our estimate of the length of the interval during which we observed the totality. It appeared to me very short—so much so that when it was over I was quite taken by surprise to hear that both Captain Tanner and Mr. Kero Laxuman had taken sketches of the flames; and their

stretches, both as to position and structure, were, with one slight exception, remarkably coincident. From the time of my first pointing the spectroscope to the bursting out of the sun's light I never once withdrew my eye, though it had been my intention to shift the prism-cap on to the telescope of the theodolite as soon as I should have carefully noted the spectrum of the flames; but while I was intently gazing on the two bright bands to impress their colour well on my memory, a new spectrum of the moon's edge appeared, so that I was under the impression that the length of the time of observation was very short. On the other hand, Captain Tanner, judging from the amount of work he did in the time, estimated it at a minute. Mr. Kero Laxuman estimated it at 40 or 45 seconds. Immediately after the totality was over we all three made rough notes of our observations; and Captain Tanner's and Mr. Kero Laxuman's notes agree together wonderfully in their description of the structure of the flames."

"The following is an extract from Captain Tanner's notes, taken almost immediately after the eclipse:— 'I at first saw three prominences—one long curved pointed tongue, and two close together, straight but flat-topped, about two-thirds the height of the former. They were of a rose-madder colour, and were decidedly more like flames than anything else, not only in their general appearance and colour, but by their being composed of smaller tongues of flame parallel (or nearly so) to the general axis of the flame, so that they had a streaky appearance, and a ragged edge. At the first glance, when the sun was somewhat obscured by clouds, I thought they were homogeneous and had hard edges; but this idea was at once dispelled when the clouds cleared off. The two protuberances, which were close together, were not, as far as I could see, joined by any smaller shots of flame. I afterwards observed one small protuberance, and marked the position of it in my sketch. I did not observe that it was streaky, as the others were—perhaps on account of its being so small, and perhaps because I had not sufficient time to examine it properly. As regards the corona, when we first began to see the eclipse through the clouds, I was under the impression that the eclipse, instead of being total was only annular, so bright was the corona near the moon's limb. I could not detect any irregularities in the structure of the corona, but the light appeared to be gradually shaded off all round.

"There is a curious coincidence which I may here mention, though I imagine it can only be regarded as purely fortuitous, viz., that the flames were almost exactly opposite the spots on the sun's disc."

J. N. LOCKYER, Esq., has forwarded the following letter to the Secretary of the Royal Society:—

"October 20, 1868.

"Sir,—I beg to anticipate a more detailed communication by informing you that, after a number of failures, which made the attempt seem hopeless, I have this morning perfectly succeeded in obtaining and observing part of the spectrum of a solar prominence. As a result I have established the existence of three bright lines in the following positions:—

- I. Absolutely coincident with c.
- II. Nearly coincident with f.
- III. Near d.

"The third line (the one near d) is more refrangible than the more refrangible of the two darkest lines by eight or nine degrees of Kirchhoff's scale. I cannot speak with exactness, as this part of the spectrum re-

quires re-mapping. I have evidence that the prominence was a very fine one. The instrument employed is the solar spectroscope, the funds for the construction of which were supplied by the Government-Grant Committee. It is to be regretted that its construction has been so long delayed.—I have, &c., J. Norman Lockyer."

Mr. B. STEWART, writing to the *Athenæum*, speaks of this discovery as follows:—

"A few days since I received the following note from Mr. Lockyer, dated the 20th of October, who had already communicated his discovery to the Royal Society: 'Got a prominence with the new spectroscope: got the positions of three lines; one corresponding to c absolutely, one to f very nearly, one eight or nine degrees of Kirchhoff's scale more refrangible than the most refrangible d line.' Recognising the importance of this announcement, I immediately sent an account of it to Mr. De la Rue, who was in Paris, and who communicated the notice to the Academy of Sciences. M. De Launay, to whom the communication was made, immediately replied as follows: 'I thank you for the new and interesting observation which I have just received, and which I shall be happy to communicate to the Academy of Sciences at their next meeting. Some minutes after I received your note a letter reached me from M. Janssen, who went to India to observe the eclipse of the 18th of August from the spectroscopic point of view. I will communicate his letter to the Academy also at the next meeting.'

"Here, then, we have a very marked instance of two observers, quite independently of each other, observing the same fact with certain differences. M. Janssen, it will be noticed, declares for hydrogen, but names no lines; he considers the bright lines as coincident with the dark lines of the spectrum. Mr. Lockyer, however, has not obtained this coincidence—in fact, in a further communication received from him, he lays stress on the want of complete coincidence except in one case, without in the meantime attempting to interpret the cause. Probably his spectroscope is more powerful than that of M. Janssen. But for this point, and doubtless many others, we must wait for the promised detailed communication to the Royal Society. These differences of fact, while they render the problem of great scientific interest, are not the only differences which ought to be borne in mind. Although the priority of observation is due to M. Janssen, yet the possibility of the discovery was suggested by Mr. Lockyer more than two years ago, and to my knowledge he has been working at it since that time; whereas M. Janssen frankly acknowledges that the idea only occurred to him during the eclipse itself. This fact was very nobly referred to by M. Faye, at the discussion which followed the announcement of the discovery at the Academy of Sciences."

The following remarks condensed from the *Saturday Review*, give a few more details of Mr. Lockyer's discovery:—

"Another stride in advance has to be recorded in solar physics—perhaps at this moment the most progressive department in science. Though much more detailed knowledge probably remains to be reached by prolonged observation, we may say broadly that the spectroscope has now revealed the nature of solar prominences—the red flames of the eclipse—just as two years ago the same beautiful method solved the sun-spot problem, and not long before settled the vexed question of the constitution of nebulae. Solar science belongs essen-

tially to our own time. The ancient faith that the great luminary was a sphere of inconceivable brightness and spotless purity was, it is true, rudely disturbed two centuries and a half ago, when Galileo and his contemporaries observed that the solar disc was subject to eruptions of dark spots long supposed to be opaque clouds or solid bodies hiding a portion of the incandescent surface. But nearly 150 years elapsed before Wilson's discovery that the spots were cavities in the photosphere (a discovery now absolutely confirmed by the modern observations of Mr. De la Rue and others), and then another century passed before it was ascertained why these cavities looked dark, and what was the nature of the disturbances which produced them. This has been the work of the last few years. Two rival theories for a short time struggled for pre-eminence, one of these, due to M. Faye, explained the phenomenon by supposing that the mass of the sun was composed of nebulous matter too much disorganized by its excessive heat to shine with much brilliancy, while the light was due to the partial condensation of the vaporous surface into incandescent particles in the cooler photosphere. A spot, according to this view, was produced by an up-rush of the superheated and less brilliant vapour through the photosphere. The other theory was supported by three English astronomers—Mr. De la Rue, Mr. Balfour Stewart, and Mr. Loewy—who had been making diligent solar observations at Kew. Their theory was based on the established fact, that while the bright photosphere full of incandescent particles envelops the sun, the photosphere itself is in its turn surrounded by an absorbent atmosphere; and they held that a spot was produced by a down-rush of this atmosphere into the region of the photosphere. Partly by displacing and partly by obscuring the photosphere, the whirlwind of atmosphere, according to this view, darkens the cavity of the spot. Much evidence was accumulated in favour of the English theory, but it was not conclusively established until the year 1866, when Mr. Lockyer applied to the investigation the same method of spectrum analysis by the aid of which Mr. Huggins had a short time before ascertained the constitution of nebulae."

In the same paper in which Mr. Lockyer announced his solution of the sun-spot difficulty, he suggested the pertinent question whether the spectroscopic might not afford us evidence of the red flames which total eclipses had revealed. The question was not a mere barren conjecture, for Mr. Lockyer employed the spectroscopic, which he had mounted for the examination of sun-spots, in diligently sweeping round the edge of the sun in search of such special spectrum as the prominences might give. From the year 1866 these observations were continued without result, and another observer, Mr. Stone, who afterwards commenced a similar search, was equally unsuccessful; but at length, in the early part of the present month, a spectroscopic of much greater power was mounted, and Mr. Lockyer was soon rewarded by a sight of the prominence-spectrum, which, so far as the observations have yet gone, appears to consist of three bright lines—one corresponding exactly to the dark line *c* in the red portion of the solar spectrum, which is commonly considered to be due to hydrogen; another nearly coinciding with the line *r* at the confines of the blue and green, which is also ascribed to hydrogen; and a third at a little distance from the conspicuous sodium lines *p*, but clearly distinct from them, and, curiously enough, without any corresponding line which has yet been noted in the solar spectrum.

"Before this result was achieved and communicated to the Royal Society, the eclipse had taken place, and several observers had gone to India and other places within the region of totality, armed with apparatus for the examination of the prominence-spectrum. All of these observers had reported that they got a spectrum composed of bright lines alone—the evidence of burning gas; but, either from the necessary hurry attendant upon observations during the few minutes allowed by the period of total obscuration, or from some other cause, the most remarkable discrepancies appeared in the positions assigned to the lines. Captain Herschel, who represented the Royal Society, reported three lines—one absolutely identical with *n*, another not quite agreeing with *r*, and the third somewhere near *n* or *c*. Major Tennant, who went to Guntoor, in India, on behalf of the Royal Astronomical Society, reported three lines, *c*, *n*, and *b*—this last being in a region where no other observer except M. Rayet saw any line at all. M. Rayet, who was at Wah-Tonne, considered that he detected as many as nine lines—*n*, *p*, *r*, *b*, another unknown line, two of the lines about *r*, and the line *a*. It will be observed that nearly all the lines named by these observers are given as actually corresponding with known solar lines. M. Janssen, who represented the Académie des Sciences and the Bureau des Longitudes, reports the hydrogen lines as the principal lines. As yet the detailed accounts from these observers have not been received; but it seems probable, from the uncertainty with which the position of some of the lines is spoken of, and the wide discrepancy between the results of different observations, that the lines were determined, for the most part, rather by estimate than by measurement. Although, therefore, the eclipse observations had removed all doubt as to the gaseous nature of the prominences, and thus anticipated the result obtained by Mr. Lockyer, the discovery that the spectrum of the prominences might be observed at any time rendered it possible to ascertain the exact position of the lines with a precision which was far from being attained in the observations made during the eclipse. Scarcely, however, had it become known that the search for the prominences had at last proved successful, when a letter arrived in Paris from M. Janssen, stating that, while making his eclipse observations, it occurred to him that he ought to be able to see the prominence-spectrum without calling the moon in aid to relieve him from the brightness of the sun. Accordingly, before returning from Guntoor, he had made the attempt, and succeeded in getting several views of the prominence-spectrum some weeks before Mr. Lockyer had achieved the same result in England. It has often been remarked how frequently scientific discoveries are made by independent observers at the same time, and perhaps the coincidence was seldom closer than in this instance. The French observer was the first who actually caught sight of the coveted object, but the Englishman had been the first by a year or two to suggest and commence the search, and was the first to publish his discovery. His results were announced to the Royal Society, and by Mr. De la Rue to the Académie des Sciences, before the arrival of M. Janssen's letter, which, singularly enough was delivered to the President of the French Academy a few minutes after a more detailed announcement of the English discovery had been received by him.

"M. Janssen's letter, which appeared in the *Moniteur* of the 25th instant, states that the prominences are principally composed of hydrogen, a result which, as to the

line c, entirely agrees with Mr. Lockyer's. We shall wait with interest to see whether, on the receipt of the more complete report which M. Janssen as well as Mr. Lockyer promises, his conclusions will be found in other respects to agree absolutely with those of the English astronomer; but it is scarcely likely, from the nature of the process, that there should be any discrepancy. One observer may, possibly, by devoting himself too exclusively to one part of the spectrum, miss a line which another detects; but, with the method of observation devised by Mr. Lockyer, a line which is once seen cannot well be assigned to a wrong place. The spectroscope being directed, to the edge of the sun shows in the field of view a narrow belt of the true solar spectrum, and beyond this comes the fainter spectrum of the sun's atmosphere, in which the prolongation of the dark lines is visible. When a prominence is reached, as the instrument sweeps round the sun, the bright line flashes out, sometimes overlapping both the spectrum of the sun and that of the atmosphere, and at other times entirely within, and then again at some distance beyond, the edge of the sun; these variations depending of course on the form and position of the prominence, and affording, as both M. Janssen and Mr. Lockyer at once pointed out, the means of tracing an actual outline of the prominence observed. Whenever, therefore, a bright line is seen, it shows itself superimposed upon the actual solar scale, and any error in assigning its position would be inconceivable. Where the line actually corresponds to a dark line it appears sometimes as striking out the black line from the bright solar spectrum, at others as prolonging it with a line of light. Both these appearances were strikingly exhibited with the line c, when we had the privilege of observing the spectrum through Mr. Lockyer's instrument; and the extreme clearness with which the line near ν came out disposed in a moment of the idea, apparently entertained by some of the observers in India, that the two were identical. Whatever this bright line may be, it is certainly not a sodium line. At present it is not certain that all the lines of the new spectrum have been fixed, and it is just conceivable that one prominence might be wanting in a line disclosed by another at a different region of the sun. But there seems reason to believe that the three lines already established form, at any rate, the principal part of the spectrum, and that these were the three lines in fact seen by most of the observers, although their positions are so differently estimated. Whether M. Rayet's nine lines will ever be confirmed by the more exact and deliberate mode of observation now shown to be available, seems doubtful. It is not, however, worth while to speculate on matters which a prolonged course of observation will translate into the region of ascertained facts; and we may be sure that the prominence-spectrum—now that it has once been caught—will not be left alone till it has given up all the knowledge which it has to communicate, much of which we hope to hear about at the next meeting of the Royal Society."

ON THE DETERMINATION OF SILICON, GRAPHITE, AND MANGANESE IN IRON AND STEEL.

BY PROF. V. EGGERTZ,

SCHOOL OF MINES, FARLUN, SWEDEN.

Silicon, Graphite.—To 4 c.c. of sulphuric acid are added 20 c.c. of water in a beaker of 100 c.c. capacity,

and when the heat produced by the combination of the water and the acid has entirely disappeared, 2 grammes of pig-iron finely powdered are shaken into the diluted acid and boiled for half an hour. (For steel and wrought-iron not less than 3 grammes should be taken, and the acid for solution added in the proportion shown above for pig-iron.) The solution is then evaporated until it measures 18 c.c., allowed to cool down the temperature of 50° C., and 4 c.c. of nitric acid sp. gr. 1.20 added, boiled for a quarter of an hour, and allowed to evaporate on a water bath, until, on holding a watch glass over the beaker, there occurs upon it no perceptible condensation. To the dry mass add 30 c.c. of water and 5 c.c. of hydrochloric acid sp. gr. 1.16, boil for a quarter of an hour, and add more hydrochloric acid if there appears to be anything besides silica and graphite undissolved in the solution. The insoluble silica and graphite are thrown on a filter, which has been dried at 100° C., and carefully weighed, washed with cold water until the washings give no iron reaction when tested with ferrocyanide of potassium; then washed with boiling water containing 5 per cent of nitric acid, taking care not to allow the acid water to enter the filtrate in which the manganese is to be estimated. The silica and graphite are then dried on the filter at 100° C., and weighed, ignited in a porcelain crucible, and the weight carefully taken. The difference between the weighings before and after ignition gives the amount of the graphite. After ignition the silica should appear quite white, any trace of red colouration showing it to be contaminated with iron. The percentage of silicon in the silica is 48.

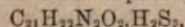
Manganese.—The filtrate from the silica is diluted with water until it measures 400 c.c., and accurately divided into two portions of 200 c.c. each, one of which is set on one side, and in the other the manganese is estimated in the following manner. (In the case of wrought-iron and steel, where 3 grammes are taken, the solution is diluted to 200 c.c., and the manganese estimated without dividing the solution.) A saturated solution of carbonate of soda is added to the manganese solution until it becomes nearly neutralised, appearing of a deep brown colour; water containing 5 per cent of carbonate of soda is then added drop by drop until a slight turbidity occurs in the solution; and if on standing in the cold this turbidity rather increases than diminishes, sufficient soda has been added (if too much soda has been added, and a precipitate is thrown down, the excess of soda must be neutralised by hydrochloric acid); to the slightly turbid solution 1½ c.c. of hydrochloric acid is added, and heated on the water bath until the solution becomes clear; dilute with about half as much water as the volume of the solution, and add 30 c.c. of a saturated solution of acetate of soda, boil for a quarter of an hour, allow the precipitated iron to settle, and decant the clear liquid through a filter, washing the iron by decantation with boiling water containing ½ per cent of acetate of soda; finally throw the iron on the filter, and continue the washing until bromine water gives no reaction, showing that all the manganese has passed through the filter; evaporate the filtrate down to 400 or 500 c.c., and at the temperature of 50° C.; add a few drops of bromine to precipitate the manganese, and keep it about that temperature for twelve hours, stirring occasionally with a glass rod; the solution after addition of the bromine becomes of a yellow or brownish colour, but should be perfectly colourless before filtering. The manganese is now thrown on a filter which has been dried at 100° C., and accurately

weighed, washed with cold water containing 1 per cent of hydrochloric acid, dried at 100°C ., and weighed. The precipitate is a hydrated oxide of manganese containing 59.21 per cent of manganese, or precipitate may also be ignited in a porcelain crucible at a white heat, and is then anhydrous oxide of manganese containing 72.05 per cent of manganese.—*Engineering*.

ON THE PRODUCTS OF THE ACTION OF SULPHIDE OF AMMONIUM UPON STRYCHNINE.

BY PROFESSOR HOW, D.C.L., WINDSOR, NOVA SCOTIA.

A PAPER, by Dr. A. W. Hofmann, announcing the existence of a compound of persulphide of hydrogen and strychnine, was given in abstract in this journal (No. 453, August 7, 1868, *Am. Repr.*, Oct. 1868, page 180). My object in referring to it is to point out that some substance is probably formed in the reaction by which the compound is obtained which has not yet received examination. The process employed is one by which, as I showed in 1855 (*Edin. New Phil. Journ.*, Jan. 1855, p. 47), the hyposulphites of some of the alkaloids are readily formed. It consists in digesting the alkaloids with sulphide of ammonium with free access of air. In conducting this operation with strychnine, I found, as first mentioned in 1854, in a paper "On the Action of the Halogen Compounds of Ethyl and Amyl on some of the Vegetable alkaloids" (*Trans. Royal Soc. Edin.*, xxi., p. 33), that a substance was produced evidently different from the hyposulphite of strychnine, a white salt crystallising in rhomboidal plates, formed at the same time. It was doubtless, the compound recently examined by my illustrious master, and possibly I should have made out its nature had I remained in an atmosphere more scientific than that into which my fate led me soon after my account of the hyposulphites referred to above was written. The compound,



of Hofmann, is described as giving beautiful needles, of an orange colour, completely insoluble in water, alcohol, ether, and sulphide of carbon. In my notes of the experiments relating to the hyposulphites, I find mention of "stars of yellow crystals," and "yellow red stars," being deposited on the walls of the vessel containing strychnine, alcohol, and aqueous sulphide of ammonium. There can be very little doubt of the body alluded to by myself in 1854 being identical with the compound in question, for the knowledge of whose composition we are indebted to Dr. Hofmann. It does not, however, appear that this is the only product of the reaction besides the hyposulphite of strychnine, for I find in the same notes mention of a yellow substance which "dissolved in hot rectified spirit and gave a semi-crystalline deposit on cooling." Again, in the description of the action of sulphuretted hydrogen on the carbonate of ethylstrychnine, I state (*Edin. New Phil. Journ.*, Jan. 1855, p. 55), "hyposulphite of ethylstrychnine may be obtained by passing sulphuretted hydrogen into the carbonate of the base, and allowing the liquid to stand exposed to a moderate heat. It is, however, in this case accompanied by a product which, to judge from appearances, is the same as that formed by the action of sulphide of ammonium upon strychnine. This substance has a yellow colour and is of extreme solubility in spirit, and nearly insoluble in water."

Hence it appears that there are two yellow bodies

formed, one only of which is as yet fully made out. I mention this because some chemist may be induced to take up an investigation which promises interesting results. I may add that I began to examine the action of sulphide of ammonium on strychnine, as mentioned in one of the papers referred to above, in the hope of ascertaining the function of the second atom of nitrogen. I was rewarded by making the acquaintance of the hyposulphites of the alkaloids, indeed, but by no definite results on the point in question; such as I obtained are now given, and I wish success to any one who chooses to take up a problem which I shall most probably never again attempt to solve.

ON A MODE OF EXTRACTING THE METALS MOLYBDENUM AND CHROMIUM.

BY J. ENEU LOUGHLIN, M.D.

MOLYBDENUM was first prepared by Hjelm in the year 1782. His method consisted in heating the trioxide of molybdenum in a porcelain crucible for two or three hours. Several other methods have since been used, prominent among them being that of heating the acid molybdate of potassium; also the reduction of molybdate of ammonium by heat, or the reduction of trioxide of molybdenum by carbonate of soda. Molybdenum is described as a silver white metal, not altered by contact with air at ordinary temperature. Sp. gr. 8.5; not attacked by chlorhydric acid or dilute sulphuric acid. Strong sulphuric or nitric acids, on the contrary, act very powerfully upon it with evolution of sulphurous acid and hyponitric acid. Having had occasion during June, 1867, to use some molybdenum, I tried the methods above stated; they were all very satisfactory as regards the yield of pure metal, but the time was rather long. I then had recourse to the reducing action of cyanide of potassium. Molybdic acid was prepared and tested according to Fresenius. The result being satisfactory as regarded the purity of the molybdic acid, 10 grains of molybdic acid thus prepared were mixed with 15 grains of cyanide of potassium placed in a porcelain crucible, which porcelain crucible with the lid luted was placed in another crucible, then surrounded by powdered animal charcoal and exposed to a white heat for twelve minutes. At that time the crucibles were removed, allowed to cool, and examined; the porcelain crucible was found lined with a brilliant silver-white metal of a sp. gr. 8.56, which was not attacked by chlorhydric acid but violently attacked by nitric acid with evolution of hyponitric acid fumes; it reduced oxide of mercury and oxide of silver when triturated with these substances. An analysis of this showed it to consist of—

Molybdenum.....	98.7
Impurities, SiO_2 , C.....	1.3
	100.0

By the same process, using sesquioxide of chromium in place of molybdic acid, chromium was obtained, possessing a sp. gr. 6.2. The best results were procured by using a reducing mixture of cyanide of potassium and animal charcoal.—*American Journal of Science*, July, 1868.

A GLANCE AT GERMAN TEACHING.

It is possible to exaggerate the value of laboratories, but it is also clear that fine work cannot be obtained by

course machinery. A friend tells us that the finest—i. e., most practical—laboratory he ever saw was in a kind of shed built by Dr. Boswell Reid, in Edinburgh, but we know how the Scots admire their own. To us it seemed that it was Liebig's new laboratory that took us fairly out of the habits of the alchemistic age. Even after it was built, Heidelberg had its chemist, a man of the highest celebrity in his department, working in a spot so furnished with black furnaces, heavy hoods, crucibles, and other fire machinery that students from the newer building scarcely could imagine what work could be there done; and if they had read poetry and romance it was, at first sight, Faust, Auerbach's Keller, and necromancy that came more readily into their minds than chemical apparatus. But if they approached the study, these distant times soon disappeared. The master sat in a clear and bright well-ordered apartment; ask him a question on any subject connected with chemistry, and before answering he goes to one of the numerous pigeon-holes on the wall and takes out loose leaves, each containing extracts from the latest publications. He himself sat as judge on all that the chemical world studied. Gmelin was a fine type of German diligence in the study. Liebig showed a rarer set of qualities; he wrote, he worked, and he stimulated. With Gmelin in the hands of every student, and the example of Liebig driving them forward, the later impulses to study chemistry began, and have continued without ceasing. This is said in full appreciation of the brilliant chemists which France then had, and we may say has always had since the science began, as well as of the fact that Berzelius was alive. But there was a force at that time, as there is still, peculiarly advancing in German action as well as thought. And even when her ideas did not lead, there was a vigour in her system of education which turned all eyes towards her. We may therefore be excused for taking her as our chief standard of comparison for our present purpose. On hastily reviewing the growth of laboratories of late, it seemed as if England were always stepping forward, although keeping behind Germany, and this even when we did not take the numbers into consideration. Few men have visited all the universities of Germany, and none, probably, have seen all her higher schools where science is taught; but many persons have seen several of these, and none have seen them without wonder. The political division of Germany has produced many peculiarities, amongst others the many centres of education. The cause lay partly in the extent of the country, united with the slow and difficult travelling. The desire for political union, the new impetus to the study of science, and the beginning of railways seem to have acted on the nation simultaneously, and there arose the love of wealth and a determination to do at least as much as England had done.

The wealth of Germany thirty years ago was very slightly developed; even twenty years ago the people were not out of the traditions of the middle ages in great towns, and even now in small towns one may almost live as in the times of Luther. But within ten years there has been a growth of manufacturing industry sufficient to have altered the features of many places, and the natives do not require to visit Birmingham for chimneys, or even the black country for dreariness. The wealth of the country is wonderfully increased, and liberty, political and personal, has followed education. Some politicians will reverse the order—and such may have been to some extent the case

in our country; but it is also very clear that without education no liberty can be complete.

The change has been preparing for a long time. The preparation has been made by attending most minutely to all details of management. The government has been like a kind but strong-willed father, that was determined to bring up every child well, but was ready also to lay his hand heavy upon him if he diverged from the prescribed route. The consequence was a certain sameness and littleness if we looked at few parts, but the extent was great. The mode of education suited the national mind, which was always attentive to small objects, even when attempting great. We find in their old books as much formality as in the present bureaux of the officials.

One sees it at the first moment of entering a hotel, where literal exactness is visible, and you are written down. If you enter a university you must undergo still more; you must have your certificate of birth and of confirmation, sometimes your certificate of vaccination and your passport; and the German who leaves his home goes carefully preserving them through all the world, as if by a kind of witchcraft he died with his description. The amount of writing everywhere done is strange to behold. If we enter still further and see his inner thoughts as displayed in his books, we find an attention to detail that surpasses the comprehension of most of us. In describing a scene, we can imagine him speaking of each object separately if time would permit; but he is obliged to be content with every species and variety, giving a fullness to his work which makes it a mine of wealth to those who search for detail. How far can we imitate him? We shall never do exactly as he does; but for a nation like ourselves, rather apt to rush to ends without making a beginning, an imitation to a large extent would be a fine training for our youths. Germany has been a slave to its details—why shall we be the same? If it has been a slave it has been for the good of mankind. It is the intellectual miser among nations—and what a glorious run we can have amongst their wealth—which they have supplied in amounts greater than we have been able to squander.

Let us try another illustration. The German intellect is farthest removed from the Irish—the first is conscious of every step in reasoning; the second leaps over a dozen, and often misses its way. The power of leaping and flying are glorious powers. One may go direct to the top of the mountain without touching the sloughs below. The German crawls through the sloughs, but he leaves behind him a good substantial road, which only requires to be illuminated to become the much-desired object—a king's highway to learning. It would be exceedingly pleasant to follow this out into the history of science, and to observe what flashes of light have gone from various nations; but it would equally surprise us to see that the German will not be behind even if he have nothing to collect for his fire but brushwood; he will heap it up until it becomes grand by quantity.

And how shall we apply these remarks to ourselves? If we differ from the Germans, why should we imitate their modes of education? There is a mode of training every animal, but not one mode for all. Some will say, then, if the German is so fond of details, let him be fed upon them; if we like conclusions, let us have them, and waste no time. But this conclusion is too hasty. It is the weakness of the German to be so fond of detail, and it is his strength to be so well ac-

quainted with detail; it is our weakness to dislike it, and it is our strength to overleap it. Among these apparent contradictions it seems hard to steer our course, but we may begin thus:—A trained man can be depended upon so far; an untrained may do better, if he has genius; and who can tell what he may have? We cannot train men to be marvels, and if they were they must still submit to some extent, and the only resource left to us is to yield to the influence of plodding in education, caring, however, to observe if any of the young thinking machines that we are polishing shew any peculiar movement which shall be indicative of progress beyond the teacher's intention. These spasmodic wilful movements may take place amongst our youths more rapidly than among the Germans; but it no less becomes us to look for fundamental training in the direction where it has been most successful. If our youth become weary sooner, it is well that we should seize on them as early as possible. It is from our Teuton friends that we have received models of careful teaching from their kindergarten upwards. These infant schools were a step beyond ours—introducing practical lessons; their laboratories are the same idea carried out. Let a man touch and handle if he will learn. Let our youth be taught natural laws by seeing them in action, not as abstractions only.

The first thing that will occur to many people to say is—"This is exactly the method of the practical English nation; the opposite has been the custom of the dreamy Germans." True we sent boys into practical life to pick up principles at random; and those who thought enough made systems for themselves. This apprenticeship method was good when principles were on the surface; but when they are so deeply sunk that generations have been required to find them, and when the phenomena themselves are not superficial, the method falls to the ground. No man can learn his duties in a chemical work by apprenticeship, or by the imitation of the actions of others.

The rapid development of the teaching of physical sciences in Germany was the result of previous training, and the rapid development of manufactures followed immediately.

But we must take the privilege of Englishmen, and rush through intermediate stages to a conclusion. That seems to be that in Germany the army of labour is organized as carefully as that for fighting. The unanimity is complete, and the determination to invade our markets is strong. Every chemical work has at least one trained chemist, and the training is careful. With us it is frequently considered needless to have one for large works, as they can go by themselves, and small works cannot afford one. We know very well that this is not universal, but some of the exceptions are more apparent than real, and at any rate we shall defer speaking on that point.

SPECTRUM OBSERVATIONS OF THE SUN.

IN continuation of our account last week (*Am. Repr.*, January, 1869, page 19), we have to report further discoveries on this subject. The Rev. Father Secchi, writing to the Abbé Moigno from Rome, says:—

"Two words, in haste, to tell you that I have been able to satisfy myself of the reality of the discovery of Messrs. Janssen and Lockyer, on the luminous rays of the solar protuberances, in full sun this morning. Yesterday I received your copy of *Mondes*, and I set to work this morning. As if by magic, after having di-

rected the spectroscope towards the apparent upper edge of the sun, I hit upon a protuberance perfectly detached from the sun's border.

"The line, c, shone in the middle of the spectrum, and so as to render mistake impossible, it was prolonged above and below by the continuation of the black line.

"At one point about 45° from the apparent northern edge towards the apparent west, I found a second brilliant ray, c, which encroached on the edge of the sun. At about 160° I found a twinkling protuberance, that is to say one which was visible at intervals, and then disappeared. Not trusting to my own eyes, I called my assistants, and all, to the number of four, saw these curious phenomena.

"Returning to the first protuberance, I distinguished the ray, r, but not so long; besides, I saw a brilliant ray beyond r, on the side of the blue, shine with great brilliancy, similar to that which separates the two widest rays of magnesium.

"A very apparent fact, and one which shows the abundant presence of hydrogen, even where it does not shine as a protuberance, is that the ray, c, vanishes almost everywhere around the sun at the same time that the ray r becomes much enfeebled. It appears that in these regions the direct light has no other effect than that of paralysing the absorption of the rest of the envelope. What consequences may we not expect to result from this discovery? I will leave till another time the studies which I have made to facilitate these observations. I may say that I have seen all this by reducing the aperture of my large glass to 8 centimetres; I feared to endanger my sight by employing a larger aperture. The spectroscope is one of Hofmann's, with two heavy flint prisms."

Mr. Lockyer has made some additional observations, which are briefly described in the following extract from a letter which he has written to Dr. Warren De la Rue:—

"Since my last communication the instrument which I used has been completed; when I commenced, it was in a very imperfect state. I have been able to recognise that the protuberances are simply local accumulations of a gaseous envelope which completely surrounds the sun, for in all parts of the circumference of the star I perceive the characteristic spectrum of the protuberances.

"After all there is something important in my communication of 1866. It is a pity that in the search after truth we depend so much on the minute adjustment of our instruments.

"The thickness of the new envelope, which I hope you will publish on my behalf, is nearly 5,000 miles; it is marvellously regular in its contour. At the pole, as at the equator of the sun, the spectroscope reveals its existence at a sensibly equal distance from the disc of the star.

"In a communication to the Royal Society I shall point out how we may determine the temperature of this new envelope."

PHOSPHATES IN AGRICULTURE.

Much attention has been given of late in France to the treatment of coprolites and other bodies containing phosphates applicable as manures; and an agricultural writer, M. Adolphe Bobierre, has given, in the *Journal de l'Agriculture*, of Paris, an account of the methods in

action, and experiments in connection, with this important question.

"Guanos from tropical regions," says M. Bobierre, "bone ashes from the pampas of Central America, phosphorites and apatites from Spain and Portugal, coprolites and nodules from the early limestone formation, the refuse of sugar-houses and refineries, gelatine and button manufactories, everything in fact which contains phosphoric acid in any quantity, is now the object of serious and generally profitable application. Guano is obtained from the giddy heights of the mountain peaks in sight of the coast of Bolivia, while in the Ardennes it is found worth while to remove sixty or more metres of argillaceous earth to obtain a ton of phosphated nodules, which, when washed and pulverised, rival bone-black.

The writer recognises the great activity of English chemists and agriculturists with respect to phosphates and the production of superphosphates, and the immense services which they have rendered; but adds that the manufacture of superphosphates cannot be said to be perfect so long as the sulphuric acid is lost.

With respect to what has been done in France, M. Bobierre gives some interesting examples. The nodules of phosphate of lime have been largely employed in Brittany, in the cultivation of the landes, in the place of bone-black, which has been used largely for thirty or forty years; this has created a very important employment, and we are told that many of the dealers in manure have entirely given up the sale of bone-black for that of pulverised fossil phosphates. Attempts have been made to separate the phosphates from the 30 per cent or more of siliceous matter with which they are associated, and also, on the other hand, to produce mixed manures, in which the activity of the phosphoric acid should be brought out in the most effective manner; these desiderata have been realised with considerable success. One process is to treat the rough phosphates with chlorhydric acid, and to recover the acid by evaporation. Another process mentioned is to convert the nodules into metallic phosphites by calcination in a blast furnace, in contact with iron ore, and then to transform the metallic phosphites into alkaline phosphates by the action of chloride of sodium at a high temperature. A third method is to attack the fossil phosphates by means of chloride of manganese with an excess of acid, obtained from the manufactories of chlorides for bleaching and other purposes; and, lastly, the fossils are sometimes simply calcined with gas-tar or other similar substances.

The writer says that the results of the above methods and experiments have confirmed him in a previously expressed opinion, that if the nodules be reduced to a powder and the powder exposed to the action of the air, and applied to soil requiring the application of phosphoric acid, the fossil phosphates are perfectly assimilated; and further, that a mixture of fossil phosphates with ordinary manure yields the most admirable results, even in the case of old cultivated lands. "Let farmers only adopt the habit of throwing fossil phosphates under the animals," says the writer; "nothing more is required."

M. Bobierre seems to consider the treatment of nodules by means of acids as scarcely called for, but recommends this process strongly in the case of phosphorites, apatites, and certain phosphatic guanos found almost in a vitrified condition.

With respect to France, the writer observes that within a short distance of the coasts of Spain and Por-

tugal where the tribasic phosphates, containing 70 to 90 per cent of phosphate, may be obtained at the rate of 2s. 6d. to 3s. 4d. per cwt., enormous quantities of hydrochloric acid are wasted, and worse than wasted, by being allowed to vitiate the air; the town of Marseilles, which converts large quantities of sea-salt into sulphate of soda, is destined to waste annually 50,000,000 of pounds of hydrochloric acid, which could, with very little trouble, be made to dissolve the natural phosphates.

In connection with the above may be mentioned a communication made by MM. Dusart and Pelouze to the Academy of Sciences. One of these gentlemen, in a work entitled "Researches on the Assimilation of Phosphate of Lime," showed that, when acted upon by the gastric juice and very diluted lactic acid, phosphate of lime underwent partial decomposition, yielding a mixture of lactate and acid phosphate of lime; this led to experiments on the action of carbonic acid on phosphate of lime, with the view to throw some light on the obscure subject of the assimilation of phosphate of lime by plants. In 1864, M. Dumas noticed that carbonic acid was a solvent for phosphate of lime, by the effect of siltzer water, in softening ivory and abstracting all the calcareous phosphate therefrom. Other chemists have regarded this action as merely a solution of the salt by the carbonic acid, but MM. Dusart and Pelouze are of opinion that the action referred to is of a more complicated character, and that the acid absorbed gives birth to new products.

These gentlemen treated gelatinous phosphate of lime with water, saturated with carbonic acid, and found that after some time the acid had partly disappeared, and the phosphate itself had notably diminished; the transparent liquid obtained by filtration deposits by heat a crystalline precipitate composed of phosphate and carbonate of lime. A series of nice experiments is then detailed to prove that bibasic phosphate of lime is produced, either by the action of carbonic acid on tribasic phosphate of lime, or by that of acid phosphate of lime on the carbonate. On this principle, say MM. Dusart and Pelouze, we have been able to produce it by the following economic practical method, in such a state of purity that, compared with superphosphate, it contains double the active power in an equal volume. The matter to be dealt with—natural phosphates, coprolites, bones or animal charcoal—are placed in wooden vats lined with lead, communicating with each other and covered with a mixture of water and acid; any acid will effect the transformation, but we prefer hydrochloric acid or the weak nitric acid, which is wasted in so many works. When the acid has macerated in one vat, we remove it into a second, and if necessary a third, and the clear liquor is finally treated with pulverised carbonate of lime; effervescence is produced, carbonic acid is thrown off, and a precipitate of white crystalline bibasic phosphate of lime is thrown down. When sufficient carbonate is used the liquor is deprived of all the phosphate that it contains, and the precipitate is easily dried and washed.

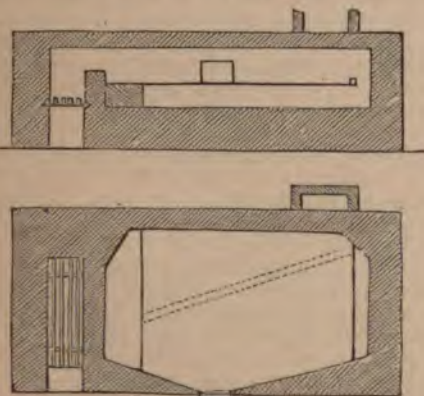
These facts enable the chemists in question to form the following hypothesis concerning the manner in which nature enables plants to take up phosphates. It is evidently in the soluble form that the plant uses them for its nutrition; the common phosphate of lime, completely insoluble in water, should therefore be rendered soluble. Carbonic acid dissolved in water performs this first transformation in the same way that the stomach of an animal renders it soluble by so

it into acid phosphate and lactate of lime. The enormous quantity of superphosphate of lime employed in England, a practice now adopted in France, is quoted in support of the above theory. The superphosphate, which, according to these gentlemen, is only an impure acid phosphate of lime, when introduced into the soil attacks the carbonate of lime, under the influence of humidity, and is thus transformed into a bibasic phosphate. As it is impossible to imagine that any substance can be entirely absorbed by plants during the first few days of its being spread upon the ground, if the superphosphates do not undergo this transformation, which diminishes their too great solubility, they would certainly be carried down to the sub-soil by the first heavy rain, and part of their value thus lost. The facility with which bibasic phosphate of lime can be produced in a state of great purity renders it a promising substitute for common phosphate, and even for superphosphate, which is always mixed with a large proportion of other matters, which have no value as manure, and of which the cost of carriage is, therefore, at any rate, a loss to the farmer.—*Journal of the Society of Arts.*

ON THE PURIFICATION OF TIN ORES FROM WOLFRAM.

BY ROBERT OXLAND, F.C.S.

Tin ores are rarely found associated with wolfram, but when this association does occur, the proportion of wolfram is frequently very large. It cannot be separated from the tin oxide by the ordinary processes of calcination and washing in water, because it is not affected by heat alone, and its specific gravity being greater than that of the tin ore, it remains mixed with it in spite of all washing. It can be separated by digestion in muriatic acid without any very great difficulty, but it is done more easily by the agency of soda ash, the crude carbonate of soda, or by salt cake, the crude sulphate of soda. The proportion of wolfram associated with the tin ore having been determined by analysis, soda ash is mixed with the dry ore in such quantity as to supply an equivalent of soda for the tungstic acid present. The mixture is calcined at a dull red heat in a reverberatory furnace, of which a longitudinal section and a plan at the level of the working bed is shown in the annexed sketches:—



In the plan, the dotted lines show the form and direction of the flues beneath the cast-iron bed, over

which the fire passes from the fire place on to the back bridge and down into the flues under the bed, and thence away to the chimney. The use of the cast-iron bed is all-important in order to prevent the combination of the soda with silica and with tin. With proper management a charge of 10 cwts. of tin ore can be worked off in four hours, so that 3 tons of ore per diem may be operated on with a consumption of less than 10 cwts. of coal.

The object of the process is to cause the decomposition of the wolfram by making the tungstic acid combine with the soda, at the same time to convert the basic protoxides of iron and manganese into peroxides, for the purpose of rendering them as light as possible to facilitate their subsequent separation by mechanical washing. This calcining operation is therefore essentially an oxidising one, and the fire should be worked accordingly. The charge drawn from the furnace should not cake. While hot it is thrown into one of a series of lixiviating cisterns partially filled with water, which is thereby rendered boiling hot. After standing a short time the liquor is run slowly off from the bottom of the vat bright and clear, and if of sufficient strength is set aside to crystallise, otherwise it is boiled up to strength before it is put into the crystallisers. The weaker liquors are used instead of water for lixiviating fresh charges of the calcined ore. Traces only of stannate of soda are to be found in the liquor if the operation be properly conducted.

Salt cake may be advantageously employed when skilled labour is obtainable; it is mixed with the ore in proportions indicated by the quantity of wolfram present. A quantity of coal dust slightly in excess of the quantity necessary for the deoxidation of the sulphuric acid of the salt cake, is mixed with the charge, and the whole is exposed until red hot in the furnace to the deoxidising flame. After this a clear fire and an oxidising flame are maintained until the tungstic acid has, by combination with the sodium, driven off the remainder of the sulphur. The charge takes about an hour longer in the furnace than is necessary for the soda ash mixture.

The charge drawn from the furnace is lixiviated in the same manner as before, and after all the soluble matter has been removed, the remainder of the charge is thrown out from the vats and subjected to a series of washing operations without any stamping, but occasionally with a small amount of scrubbing, whereby the peroxides of iron and manganese are washed off. The last traces of these oxides may be removed by digestion for a few hours in muriatic acid, leaving the binoxide of tin, or black tin of the Cornish miner, nearly pure, capable of producing, by smelting, the finest quality of metallic tin.

CHEMICAL APPARATUS.

BY W. P. DEXTER.

Gas Lamps for the Ignition of Crucibles, &c.—The ordinary Bunsen burner is known to act upon the surface of platinum vessels brought into contact with the inner line of the flame; the metal loses its polish, becoming superficially porous and spongy, and requires the use of the burnisher to bring it back to its original state. This alteration of the surface I have found to be attended with a change of weight, so that for some years I have used a lamp of different construction for the heating of platinum crucibles in analytical operations. Such a

lamp may be made by removing the air tube of a common Bunsen lamp and putting in its place a somewhat longer one of glass or iron of about 12 millimetres internal diameter. The gas jet should have a single circular aperture, and be in proper proportion to the diameter of the tube, which may be held in any of the ordinary clamp supports. The tube being raised sufficiently above the jet to allow free entrance of air, and a full stream of gas let on, a "roaring" flame is produced, of which the interior blue cone is pointed, sharply defined, and extends only about half an inch from the top of the tube. A polished platinum surface is not acted upon by this flame provided it be not brought into contact with the interior cone. In the Bunsen burner, as usually made, the supply of air depends upon the diameter of the tube, the holes at its base being more than sufficient to supply the draught. With the wider tube it is necessary to limit the admission of air by depressing the tube upon the lamp when the force of the gas is diminished. Otherwise the proportion becomes such that an explosive mixture is formed; for this reason it is more convenient to use an arrangement in which the access of air can be regulated by an exterior tube sliding obliquely downward over the air apertures. The gas jet should be on a level with the top of these apertures, which must be much larger than those of the ordinary Bunsen's burner.

On account of the liability to explode and burn at the jet inside, the lamp is not well adapted for ordinary use; but for ignition of crucibles, working of glass, &c., it has proved efficient and practical.

Gas Regulator.—Now that gas is universally used as a source of heat in laboratories, it is desirable to have a means of keeping the pressure constant, and independent of the changes which take place in the mains. By the regulator of Kemp a uniform temperature can be kept up for any length of time; but this apparatus is a little difficult to adjust, is not universally applicable, and can be used in but one operation at a time. By regulating the pressure of the gas, on the other hand, a constant supply of heat is furnished, but the temperature is not so exactly maintained in consequence of the more or less rapid abstraction of heat by change of temperature of the locality, and from currents of air. It is, however, as constant as it can be kept by a spirit lamp, which we are at present often obliged, from the variations of pressure, to substitute for gas; while the regulator may be connected with several burners, or even include the whole laboratory, if the gas pipes are of sufficient size.

The arrangement which I have had in use for the last year consists of a common gasometer, made of zinc, and about 9 inches in height and diameter. The floating bell is connected by a jointed rod with a stopcock in the pipe by which the gas enters. When the bell rises from the pressure of the gas, it gradually closes this cock, and thus cuts off the further supply. The gas is then under a constant pressure depending upon the weight of the bell; as gas is consumed the bell sinks, and opening the cock allows more to flow in. The difference of weight of the bell from its greater or less immersion in the water is inappreciable; a very slight diminution of pressure, hardly perceptible without a microscope, is observed when one of the outlets is suddenly thrown open to its full extent, and is due, probably, to the friction of the gas in the tubes, which should therefore be of considerable size.

The apparatus should not be painted, as oil is acted upon by water, which has been long in contact with

gas. Asphaltum varnish seems to answer better.—*American Journal of Science*, July, 1868.

RESEARCHES ON THE ESTIMATION OF PHOSPHORUS CONTAINED IN CAST-IRON.

BY M. V. TANTIN.

It is well known that the presence of a very small quantity of phosphorus in cast-iron does not produce any sensible modification in its properties; it nevertheless loses its most essential qualities when the proportion of contained metalloids amounts to some thousandths; the importance of ascertaining the exact proportions of phosphorus in cast-iron is, therefore, self-evident. Almost all the methods hitherto proposed consist in treating cast-iron with oxidising agents in such a manner as to cause the phosphorus to pass into the condition of phosphoric acid, which is deposited as a magnesian compound; several sources of error are inherent to this method for the following reasons:—

1st. Part of the phosphorus escapes the action of the oxidising agents, and evolves as a hydrogenised compound.

2nd. It is necessary to work upon very dilute liquids in order to avoid an admixture of oxide of iron with the ammoniaco-magnesian phosphate; under these conditions it is difficult to collect the small quantity of phosphate disseminated upon the sides of the vessel in which the precipitation takes place.

3rd. Any arsenic which may be contained in the cast-iron will be discovered in the precipitate as an arseniate, whose insolubility is equal to that of the phosphate.

When seeking the means of avoiding these sources of error, I concluded that the best way of so doing would be to use a precisely contrary method, namely, by liberating the phosphorus as an hydrogen compound; but one objection naturally arose—would the totality of the phosphorus pass into the state of a gaseous product? I may safely affirm that I have never been able to discover the least trace of phosphorus in the residue after the complete attack of the cast-iron by chlorhydric acid, which fact is not surprising if it be considered what strong affinities phosphorus has to hydrogen. The phosphide of hydrogen produced by the action of chlorhydric acid upon cast-iron is almost always accompanied by sulphuretted, arseniated, and carburetted hydrogen. In order to effect the separation of these gases I first pass them into a Woulff's flask containing a solution of potash, which absorbs the sulphuretted hydrogen; the other gases are then made to traverse a solution of nitrate of silver, which transforms the arseniated hydrogen into arseniate of silver soluble in the liquid, which has become slightly acid, whilst the phosphuretted hydrogen precipitates the silvery solution and forms an insoluble phosphide. The phosphorus being thus completely separated from the sulphur and arsenic, its estimation is effected in the simplest manner, the phosphide of silver is treated with aqua regia, and thus transformed into chloride of silver and phosphoric acid, which is precipitated in the state of ammoniaco-magnesian phosphate; this precipitate when calcined gives a weight which serves to calculate the proportion of phosphorus. To ascertain the amount of phosphorus contained in cast-iron, the following precautions are indispensable.

1st. The cast-iron must be attacked very slowly, or part of the phosphuretted hydrogen may traverse the solution of nitrate of silver without being absorbed.

2nd. When the attack of the cast-iron is finished, a current of hydrogen, previously washed in acetate of lead, must be passed through the trough.

The solution of potash will contain all the sulphur in the matter under analysis; if this body is to be estimated, the solution must be treated with acetate of lead. The precipitate first formed is a mixture of oxide and sulphide of lead, but the oxide soon re-dissolves, and there remains only the sulphide, PbS. This precipitate is collected on a tarred filter, washed with distilled water, completely dried at 100°, and weighed.—*Comptes Rendus.*

MILDEW IN COTTON GOODS.

MR. J. C. LEE has sent a communication to the *Manchester Guardian* on the above subject, of which the following is a condensed account:—

It appears to me that only a few means are requisite to almost, if not completely, prevent mildew in cotton goods on shipboard. In the first place the size should be perfectly fresh—that is, not made from mouldy flour, nor permitted to become either mouldy or sour before use. This is absolutely necessary to prevent the formation or deposit of the spores or germs of mildew. It should also be free from extraneous mineral matters, and especially deliquescent substances, which, however good the size may be in other respects, would attract moisture, and thereby contribute the only requisite (all others being present) for the development of fungi or mildew. In the second place, the compartment of the vessel in which the goods are stored should be well ventilated and heated.

Shippers can, I believe, obtain from the seller a guarantee of the purity of the size. If not, however, they have an easy remedy in their own hands. Any analytical chemist can with facility in comparison with an equal weight of a standard piece of cloth determine the purity of another piece. This can be done in a simple and almost mathematically correct manner, and, therefore, reliably for commercial purposes, by thoroughly drying say 50 grains of the cloth, and noting the loss in weight, that is moisture, then igniting, and weighing the ash. Indeed, for all practical purposes, merely igniting, weighing the ash, and comparing its weight with that of the standard would be sufficient. The increase over the standard multiplied by two would give the percentage of mineral adulteration of the size. It is true there are certain salts, as chloride and sulphate of ammonium, &c., which, being volatile, would be driven off by ignition, and would not, therefore, be found in the ash. But they are too expensive to add to size, and their presence being easily recognised would in my opinion preclude the possibility of their admixture. With respect to ventilation and heating, the former requires at most a little mechanical contrivance suitable to the position of the goods or construction of the vessel. Heating could be effected by means of pipes. Manufacturers would be very glad to adopt any safe and reliable guide to assist them in the purchase of flour, but very few of these gentlemen are chemists, and hence they are liable to deception. I am persuaded they are too often blamed for using bad size, when they have done their best to procure the best quality of flour. I beg to suggest for their use also the test I have proposed for yarn and cloth—comparison to be made as before with the ash of say 50 grains of any sample and the ash of 50 grains of a standard quality of flour. The difference in weight multiplied by two will

give the percentage of admixture. If it would not be considered too tedious it would be well to shake up a couple of ounces of the flour with a pint of water, leave it to settle ten minutes, and dip into the solution a leaf from a litmus book, or decant the fluid and shake it a few minutes with a few drops of tincture of litmus, and compare the result with that of a similar experiment on a model or standard sample. It is needless to say anything of the importance of the colour and smell of flour. I almost forgot to state that if $\frac{1}{2}$ lb. of yarn or cloth were worked a few minutes in just sufficient cold water to cover either, left to steep half an hour, then wrung out, and a three or four ounce white glass bottle of the solution shaken up three minutes with a few drops of tincture of litmus, in case of an impure or mouldy size having been used, the reaction would be very different from that resulting from similar treatment of yarn or cloth to which pure size was applied.

Within the last few days I have, on inquiry, been informed by manufacturers that magnesium sulphate or Epsom salt is regularly sold for size admixture. I have also been apprised, on credible authority, that 150 tons of this substance are disposed of weekly in Manchester for this purpose alone. This is a ponderous quantity, and its statement will, I think, be advantageous to those who are financially interested in the matter. Commercial magnesium sulphate, moreover, contains 51.21 per cent of water, while, owing to its contamination with foreign salts, it is deliquescent, or attracts moisture from the atmosphere, without which fungi or mildew cannot exist. There are mineral substances that can be adopted with safety, and if size adulteration must prevail they should at once, at least for India goods, be substituted for Epsom salt.

FOREIGN SCIENCE.

PARIS, NOV. 4, 1868.

Laws of Double Decomposition—Manganoso manganic Fluoride.—Eruptive Rocks.—Ozone Free from Nitrous Compounds.

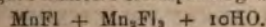
BERTHOLLET wishing to give an explanation of the law bearing his name, stated that when two salts formed of different acids and bases encounter each other in the same solution, the liquid will contain also in a certain proportion the two other salts resulting from the double decomposition of the first. In the case of an acid and a salt, or a base and a salt, he stated in effect, that after solution, the liquid should contain, besides the two bodies dissolved, the acid or the base of the salt in the free state, as well as the salt resulting from double decomposition. M. Méhay has experimented upon this subject with the aid of an endosmometer. The vessel was circular, and the active surface a sheet of parchment paper, which remained the same for all the trials; these experiments were all made at sensibly the same temperature $+ 10^{\circ}$ C.

In a first experiment, there were placed in the endosmometer a half litre of liquid, containing 205 alkalimetric degrees of sulphuric acid, or 10 grammes of monohydrated acid, and an equivalent quantity of chloride of magnesium, which we may also represent by 200 degrees in equivalent sulphuric acid. The endosmometer was placed in a reservoir containing 1 litre of distilled water, and the experiment left to itself for an hour. At the end of this time the water of exosmosis was collected and submitted to ordinary analytical processes. The following results, which are still expressed in equivalent degrees, were obtained:—Free acid, = 25.00; sulphuric acid, = 7.50; chlorine, = 19.15; magnesia, = 2.60. Evidently, from these figures, the water of exosmosis contained in the free state a portion of both the acids; in fact, the quantity of chlorine found being 19.15 degrees, and that of magnesia 2.60 only, this liquid contains at the least $(19.15 - 2.60 =) 16.55$ of

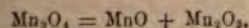
free hydrochloric acid. Likewise, with the sulphuric acid a minimum of $(7.50 - 2.65) = 4.85$ degrees.

The existence of these acids in the free state in the water of exosmose being thus proved, one may conclude that these two bodies existed also in the free state in the solution experimented upon. But the sulphuric acid and the magnesia being there in equal equivalents, it is evident that if a part of this acid is in the free state, an equivalent quantity of magnesium should be in the state of chloride. From the presence of free hydrochloric acid in the solution that of an equivalent quantity of sulphate of magnesia may be inferred. The exactitude of Berthollet's hypothesis is thus demonstrated for this case. The experiment described above was repeated, employing in the same conditions 200 degrees of hydrochloric acid and 200 degrees of sulphate of magnesia; in the water of exosmose the quantities of the components were sensibly the same as those obtained in the converse experiment, viz., free acids, $= 24.15$; sulphuric acid, 7.40 ; chlorine, 19.20 ; magnesia, 2.45 . Hence the state of the salts in solution may be considered the same in both cases. If in the trial previously made, the amount of sulphate of magnesia remaining constant, the proportion of hydrochloric acid be augmented, according to Berthollet, the quantity of chloride of magnesium, and consequently the quantity of free sulphuric acid, should augment in the same sense. Hydrochloric acid exerting only a feeble influence on the diffusive power of sulphuric acid, the amount of sulphuric acid in the water of exosmose should increase progressively. This result has been obtained by experiment. However, when the two acids differ little in energy, a somewhat different case presents itself. In repeating the experiments with the endosmometer upon a mixture of sulphate of soda and boracic acid, the amounts of sodium and sulphuric acid in the water of exosmose were found to be in equivalent proportion. A similar result was obtained with acetic acid and sulphate of soda, or sulphate of magnesia. M. Méhay says, that in this case it is necessary to admit that chemical action does not take place, or at least that the quantities of borate or acetate formed are inappreciable.

At one of the recent meetings of the Academy, M. Nicklès presented a memoir on "Manganoso-manganic Fluoride." When pure peroxide of manganese is treated with hydrofluoric acid, as in making fluomanganous acid, the solution sometimes becomes covered by an abundant brown crystallisation; this is more frequently produced when operating with a warm solution. M. Nicklès separated some of these crystals, which upon analysis gave numbers corresponding with the formula,



Manganoso-manganic fluoride is soluble in water, which becomes coloured brown; it is decomposed by much water like fluomanganites, giving rise to a brown deposit of oxide; with the alkaline carbonates it produces effervescence, oxide of manganese being deposited. With fluoride of potassium, a rose-coloured precipitate is formed. Like fluomanganous acid, it corrodes silver; agitated with silver foil or powder, the solution gradually dissolves this metal, at the same time passing into the state of protofluoride and becoming colourless. Nevertheless, the solution always contains a little manganese, and fluoride of potassium causes a precipitate which contains fluorine, manganese, silver, and potassium in very variable proportions. In general, manganoso-manganic fluoride reacts like sesquifluoride and perfluoride of manganese. M. Nicklès has previously stated that while MnFl resembles MnCl_2 by its composition, it differs in properties, being more stable than the chloride, and playing freely the part of an acid. After this, to find it uniting to MnFl , forming a fluosalt capable of ranking with



is not astonishing. Here is then, says M. Nicklès, a fresh fact to apply to the tendency already recognised by him in the singular compounds of chlorides, of compounds being proportionately acid to the lowness of the equivalent, and of their gaining stability in the same proportion. Analogous results have been obtained with iron; M. Nicklès promises to communicate them to the Academy shortly.

PARIS, NOV. 18TH, 1868.

New Uses for Mica.—Influence of Coloured Rays on the Decomposition of Carbonic Acid by Plants.—Naphthaline Scarlet.

Few uses to which mica can be placed have been found up to the present time. M. Puscher lately drew the attention of the Industrial Society of Nuremberg, to the Siberian mica, which occurs in very fine plates, and indicated some new purposes to which it could be applied. When the thin plates of mica are cleaned with concentrated sulphuric acid, and silvered in the same way as glass, they take a lustre similar to that of silver, and being pliable they can be employed in the covering of various ornaments. By heating the thin plates, and afterwards exposing them for a very short time in a muffle heated to bright redness, an aspect of matted silver is given. It is necessary to avoid heating the mica too long or too powerfully, since in either case a yellow shade is communicated, as well as great brittleness. The silvery substance formed is distinguished from metals by the property of resisting nearly all reagents; it is not in the least altered by sulphuretted combinations, by the sun, water, air, concentrated acids or alkalis.

M. Cailliet has published a research "On the Influence of Various Coloured Rays on the Decomposition of Carbonic Acid by Plants." In the experiments here recorded, M. Cailliet made use of covers or bells formed of plates of coloured glass united to each other by plates of lead. It was established in the first place to render the results comparable, that leaves of the same plant and of equal surfaces decompose sensibly the same volumes of carbonic acid when they act on identical gaseous mixtures exposed to the same luminous source. Coloured leaves, which nearly always contain a certain quantity of chlorophyll, decompose carbonic acid equally, but slowly, while the entirely white parts of the leaves of the *Aspidistra elatior*, and several other plants, are without decomposing action. All green plants do not act with the same energy on carbonic acid; there are very sensible differences which have already been signalled, but not completely examined. The absorption of carbonic acid and the disengagement of oxygen more or less mixed with nitrogen appertain exclusively to the parts of the plants which contain the green matter; but it is indispensable that these organs be intact, for in scraping or even rubbing them this property is permanently destroyed. A leaf may, however, be cut carefully into very small pieces, and still each piece, containing all the anatomic elements, possess the decomposing property. A little apparatus was constructed of two vessels soldered at the base, and having an opening at the top where a concentrated solution of iodine in bisulphide of carbon could be introduced. With this disposition, the solution being permeable only to the obscure rays of heat, carbonic acid mixed with air suffers no decomposition, notwithstanding the prolonged action of solar rays. The divers coloured rays have, on the contrary, a special action, more or less powerful on the dissociation of carbonic acid. An examination of the tabulated results obtained by M. Cailliet shows that the calorific rays as well as the chemical rays are without action on the dissociation of carbonic acid by plants. It would seem, from an inspection of these results, that the colours the most active in a chemical point of view (in regard to the colouration of chloride of silver, *e. g.*) are those which favour the decomposition of carbonic acid the least. Yellow induces the largest decomposition, and red next; violet and blue affect it but little. With green light, whether from the colour contained in vegetables, or from solutions of coloured glass, the action is peculiar. Under this influence the decomposition of the carbonic acid is *nil*, a new quantity of this gas is on the contrary produced by the plants.

A new colour, naphthaline scarlet, has been obtained by M. Schiendel. After producing nitronaphthaline, by acting upon naphthaline with nitric acid not stronger than 45° , in the cold, he transformed it into naphthylamine by the ordinary reducing method. Among other reducing agents,

tried zinc in impalpable powder in the presence of an alkali; with the naphthylamine furnished by this reaction, M. Schiendel obtained a new colouring matter which the other naphthylamines do not give. This point established, he endeavoured to isolate the new alkaloid, which gives birth to the colouring matter. Fractional distillation gave it in an almost state of purity. It is a liquid, crystallising somewhere about 0° ; it distils at a higher temperature than naphthylamine. The base is oxygenated and can form salts. The method of operating to obtain the naphthalene scarlet is as follows:—

1. The oily alkaloid is heated with nitrate of protoxide of mercury, as in the preparation of nitrate of rosaniline; there is thus formed a brown colouring matter which is isolated from the mercury and tarry products formed.

2. This brown colouring matter is afterwards mixed with a proportional quantity of naphthylamine, and heated until the fawn tint is completely changed. The red colouring matter has then to be purified by the employment of the ordinary means for aniline colours. In the pure state the colouring matter is solid, reflecting light brilliantly, and soluble in alcohol; it dyes all fibres. No detailed method can be given; unfortunately the production of this alkaloid is uncertain, sometimes even none is obtained.

PARIS, NOV. 25, 1868.

The Testing of Colouring Matters.—Glycerine Bath.—New Voltaic Battery.

IN technical chemistry, a useful contribution has been made by M. Houzeau,—we refer to his paper entitled "Observations on the Mode of Testing Colouring Matters, and particularly Extract of Logwood." M. Houzeau remarks that as long as the colouring matters sent into commerce are adulterated with inert matters, such as sand, exhausted tar, sawdust, molasses, &c., successive exhaustions furnish the required indications. When, however, substances of less commercial value, like sumac, extract of chesnut, &c., are added, this is not the case. For while these ingredients, added to the colouring matters to lower their price as much as possible, do not possess colouring power to any extent in the proportions employed in dyeing, they nevertheless, when present in extract of logwood or madder, exalt very notably the tinctorial power of these important products. Thus, logwood mixed with 10 per cent of chesnut, though it contains less hæmatine or hæmatoxyline than the genuine extract, yields with iron and aluminous mordants, richer shades. It is therefore evident that, by adulterating the colouring matters of commerce with perfectly inert substances, and correcting the diminution of strength by a determinate amount of certain astringent principles, as extract of sumac or chesnut, the usual examination will not detect the fraud. Some other simple means of testing are rendered necessary. Any adulteration of molasses is of course easily detected by the exaggerated proportion of glucose present in the suspected extract. But it is considerably more difficult to detect the astringent matters, and especially the chesnut. The difficulty of separating the astringent principles, and distinguishing those which exist normally in the extract, led M. Houzeau to adopt the following method:—1 gramme or 1 decigramme of the suspected extract, previously dried at 110° , is entirely exhausted with absolute ether, and the weight of soluble matter noted. The residue is then treated with absolute alcohol until completely exhausted. A comparison of the results thus obtained with those furnished by a genuine extract treated in the same way, furnishes a very good indication. For example, 100 parts of extract gave—

	Matters soluble in ether.	Matters soluble in alcohol.
Genuine extract.....	87.1	14.3
Suspected extract.....	76.9	19.5

These figures indicate the weight of the residue obtained by evaporating the solution, and comprise consequently products of the oxidation of the alterable matters. Extract of chesnut

scarcely yields anything to ether, while it is sensibly soluble in alcohol. It is therefore natural to find in the suspected extract more principles soluble in alcohol than in the genuine extract. A further knowledge concerning the principles present may be obtained by testing the dyeing power of the alcoholic and ethereal extracts. For the same weight, the products soluble in alcohol and ether of every extract should dye, in a similar manner, the same surface of calico if they have the same composition; this is the result of experiment. In the sample above cited, the same weights of the products soluble in ether of the genuine and the suspected extract have tinted equally the same surface of mordanted tissue, while equal weights of the matters soluble in ether have furnished totally different results.

M. Vogel recommends the substitution of glycerine for oil when constant temperatures above 100° C. are required. Glycerine of 1.25 density boils at 128° . A mixture of glycerine water, in equal proportions, boils at 102° ; glycerine 150 parts and water 100 parts, at 106° ; and glycerine 175 parts and water 100 parts, at 109° . The inconveniences of the oil bath are thus unnecessary.

A new arrangement for furnishing currents of electricity has been made known by M. Ney. It is composed as follows:—(1) a vessel filled with solution of chloride of ammonium, containing a plate of amalgamated zinc; (2) a porous cylinder filled with carbonate of copper, into which a plate of copper plunges. To maintain the battery in action, it is only necessary to add solid chloride of ammonium from time to time. In military telegraphy, where the pile should be capable of transport, the outer vessel might be filled with sand saturated with a solution of chloride of ammonium in the place of the solution. This arrangement recommends itself on the score of cheapness, for native carbonate of copper answers sufficiently well, and it likewise only requires attention while in actual use. Carbonate of copper is insoluble in a solution of chloride of ammonium, but upon closing the current, the chloride is decomposed into hydrochloric acid and ammonia; the hydrochloric acid collects at the zinc pole, the ammonia at the copper. The carbonate of copper becomes soluble, and its reduction gives rise to a secondary current having the power of a Daniell's element. This form of battery is perfectly constant.

REPORTS OF SOCIETIES.

ACADEMY OF SCIENCES.

PARIS, SEPT. 14TH, 1868.

New Combinations of Orcine.—Researches on the Combustion of Oil.—Analysis of a Meteorite.

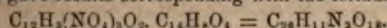
THE only paper of chemical interest communicated to the Academy on September 14th was "A Note on a Process for obtaining Pure Hydrogen without Odour by the Action of Chloride of Ammonium on Zinc," from M. Delaurier. At the meeting on the 21st, M. Tenzsch informed the Academy that he had discovered microscopic aquatic plants in certain rocks termed eruptive; MM. L'Hôte and St. Edme addressed a note on "The Generation of Ozone in Oxygen and in Air influenced by the Electric Spark of Condensation," and M. Commaille a note "On Phosphoretted Hydrogen, and on the error it may occasion in the Determination of Oxygen."

MM. L'Hôte and St. Edme, in connection with the application of ozonised air in ventilating large buildings, have examined the character of the ozone obtained in passing air through Ladd's condensing apparatus. They find the air leaving the apparatus to be free from nitrous compounds.

On the 28th, M. de Luynes communicated a memoir "On some New Combinations of Orcine," and MM. Scheurer-Kestner and C. Meunier "An Account of their Further Researches on the Combustion of Oil;" M. Pisani communicated "The Analysis of a Meteorite which fell at Orans on the 11th July, 1868."

Orcine combines directly with picric acid to form a definite

compound which is prepared in the following manner:—Picric acid is placed in a porcelain dish with a quantity of water insufficient to dissolve it, and the mixture heated to ebullition. The undissolved picric acid forms an oily layer at the bottom of the dish. On adding orceine gradually, each fragment is observed to dissolve, forming a red tint, at the same time that the proportion of undissolved picric acid diminished. At a certain moment the quantity of orceine added is sufficiently great for the whole of the picric acid to be dissolved. For 20 grammes of picric and 100 grammes of water, 12 or 14 grammes of crystallised orceine are required. On cooling, crystals resembling in colour bichromate of potash make their appearance. The crystals are drained quickly and placed in vacuo; they become yellow in drying. The compound thus obtained is very deliquescent; it is soluble in alcohol and in ether. Benzol destroys the combination. Heated on platinum, it fuses and burns with a bright flame. Analysis gave results corresponding with the formula—



The compound thus contains equal equivalents of orceine and picric acid, and may be ranged with the products that picric acid forms with carboic acid and certain hydrocarbons. The aqueous solution dyes silk in the same way as a solution of picric acid; orceine might possibly serve to facilitate the solution of picric acid.

Pyrogallie acid in presence of picric acid and water behaves similarly to orceine; it forms a compound crystallised in large plates, blackening slightly in the air, and containing picric acid and pyrogallie acid.

Orceine combines with nicotine. When aqueous solutions of orceine and nicotine are mixed, an oily matter is precipitated, which collects into slightly pink drops. This compound is dissolved in an excess of nicotine. Pyrogallie acid gives, under the same circumstances, an oily product gradually browning in the air. M. Wurtz has shown that in certain cases oxide of ethylene comports itself towards certain salts as a base; thus it displaces magnesia from chloride of magnesia. Oxide of ethylene appears to combine with orceine, like organic bases. On introducing a piece of solid orceine, previously fused, under a bell jar full of gaseous oxide of ethylene, the orceine gradually liquefies, at the same time the gas is abundantly absorbed; 1 gramme of orceine absorbs more than 400 c.c. of oxide of ethylene at ordinary temperature and pressure. By contact with solid potash the gas is set at liberty. The aqueous solution of orceine dissolves rosaniline, becoming of the intense colour of an alcoholic or acid solution. Finally orceine seems to combine with chloride of sodium.

M. Pisani in his analysis of the meteorite which fell on July 11th, 1868, at Ornans (Doubs), after the complete analysis gives the following numbers for the proximate constituents:—peridot, 75.10, unattackable silicate, 15.26, nickeliferous iron, 1.85, magnetic pyrites (Fe_7S_8), 6.81, and chromiferous iron, 0.4. He remarks that the proportion of peridot in this meteorite is much larger than in any other known.

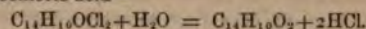
PARIS, OCT. 5TH, 1868.

Dispersive Power of Gases and Vapours.—Facts serving to Complete the History of the Bodies of the Stilbic Series. —On the Mixtures of Gold and Silver from Kongsberg.

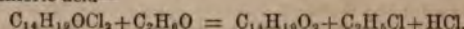
At the séance of the Academy on the 5th of October the following memoirs were communicated:—"Researches on the Mechanics of Atoms," by M. Lucas; "On the Dispersive Power of Gases and Vapours," by M. Croullebois; "On some Facts serving to complete the History of the Bodies of the Stilbic Series," by M. Zinin; "On Isopropylcarbylamine and Isopropylamine," by M. Gautier; "Observations relative to the Preservation of Wood," by M. Boucherie; "On the Mode of Testing Colouring Matters, and especially Logwood, by Dyeing," by M. Houzeau; "On the Mixtures of Gold and Silver from Kongsberg," by M. Hiortdahl; "Note on a New Element of the Pile," by M. Ney; "Note

on the Geological Constitution of the Neighbourhood of Thebes," by M. Delanoue; and "Remarks on the Fossils from the neighbourhood of Thebes, and Classification of the Beds containing them," by M. D'Archia.

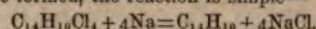
M. Zinin states that chlorobenzile heated with water in a sealed tube to 180° C. is completely decomposed into benzile and hydrochloric acid—



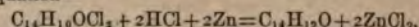
Heated with alcohol, it is decomposed more easily at a lower temperature into benzile, chloride of ethyl, and hydrochloric acid—



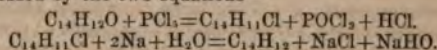
Chlorobenzile heated to 200° with an equivalent quantity of pentachloride of phosphorus, is converted into a body having the composition $C_{14}H_{10}Cl_4$. This quadrichlorinated compound is only slightly soluble in ether and alcohol, and insoluble in water. It is difficultly attacked by nitric acid, a nitrogenous product being the result. It is not converted into benzol by the action of superheated water and alcohol. In boiling alcohol it is easily decomposed by sodium amalgam and converted into a hydrocarbon, the composition of which is expressed by the formula $C_{14}H_{10}$. No accessory products are formed, the reaction is simple—



Chlorobenzile dissolved in alcohol and submitted to the action of zinc and hydrochloric acid, is soon transformed into nearly pure desoxybenzoin; the reaction is expressed by the equation—



The preparation of desoxybenzoin by the action of reducing agents presented some difficulties; now after having found so convenient a reaction, M. Zinin has been enabled to prepare this body in sufficient quantity to continue his researches on its metamorphoses. Among other results, M. Zinin has found that by reacting with sodium amalgam upon the product of the action of pentachloride of phosphorus upon desoxybenzoin, stilbene is obtained. The reactions are expressed by the two equations—



If the oily product obtained by the action of pentachloride of phosphorus upon desoxybenzoin be treated with potash and distilled or heated to ebullition, crystals of tolane ($C_{14}H_{11}Cl$) are obtained. Thus M. Zinin remarks, by a series of reactions easily understood, one is enabled, in separating the benzoin, to form hydrocarbons which can serve as the point of departure for forming benzoin, and consequently all the bodies of the stilbic series.

The native silver found at Kongsberg always contains a little gold, the proportion of which, according to numerous analyses, varies from 0.002 to 3 per cent. Rich mixtures of gold are actually very rarely found. According to the researches of M. Hiortdahl, it seems probable that these mixtures occur in quartz veins of a different character to the ordinary argentiferous veins, which are filled with calcspar as the principal mineral. As to the composition of the mixtures of gold and silver from Kongsberg, M. Hiortdahl can only find a single indication in mineralogical literature, an analysis by Fordyce in Brooke and Miller's "Mineralogy;" the gold is there given at 28 per cent. The following results for similar mixtures are those of M. Hiortdahl in conjunction with M. Samuelsen:—

Locality.	Mines.	Percentage of gold.
Bestandige.....	Liebe.....	53.1
Louise.....	Augusta.....	50.0
Froken.....	Christiane.....	45.0
Incog.....	(Fordyce's Result).....	28.0
Blaarud.....	Christiane.....	27.0
Froken.....	".....	26.9

Although the differences in the analytical results would scarcely suggest perfectly definite chemical combinations,

it may at the same time be remarked that the proportions of gold indicated seem to relate to two distinct groups, approaching in composition AuAg and Au_2Ag_3 . The numbers found by calculation for these two combinations are 47.6 and 26.7 per cent. These mixtures have a different composition from others of the same class at present known, and which always contain more gold and less silver. The silver which comes from the works sometimes contains a little more gold than the analysis of the argentiferous mineral indicates. The cause of this is that a certain part of the ore is smelted with pyrites containing a little gold, which collects in the melted sulphides (mattes). In these pyrites the gold is probably combined with selenium and tellurium, the presence of which in the mattes is easily proved, in quantity about 0.05 per cent. According to M. Samuelsen, the Kongsberg gold contains 5.5 per cent of platinum and a trace of palladium.

PARIS, OCT. 12TH, 1868.

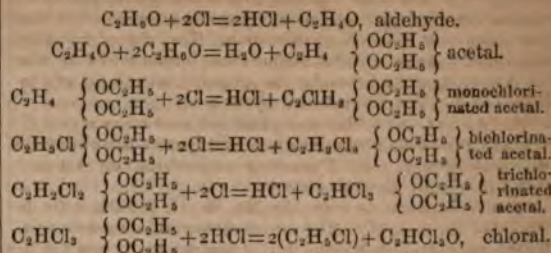
Researches on the Bleaching of Tissues.—Chromiferous Iron.—Trichlorinated Acetal from Ethyl and the Formation of Chloral.

THE following memoirs were communicated to the Academy on the 12th October:—"Researches on the Bleaching of Tissues," by M. Kolbe; "Temperature of the Atlantic Ocean compared with that of the Air, and with the Ozonometric condition from St. Nazaire to Havana," by M. Poey; "Chromites of Iron," by M. Clouet; "The Trichlorinated Acetal from Ethyl, and on the Formation of Chloral," by M. Paterno.

M. Clouet has analysed a specimen of chromiferous iron, which has the composition $\text{Cr}_2\text{O}_3, 2\text{FeO}$. In analysing specimens of this mineral from various localities, he has always obtained a constant relation between the oxides of chromium and iron, when taken from the same locality, especial care being taken to select for analysis the samples differing most in appearance. Chromites of iron are easily produced artificially. For this purpose a concentrated solution of sulphate of protoxide of iron, and solution of sesquichloride of chromium, are mixed in the proportion necessary for the combination it is desired to form, and ammonia added in slight excess. The precipitate is filtered as quickly as possible, and heated with a little carbonate of ammonia and borax in a platinum crucible to bright redness. All the physical and chemical characters of the corresponding native chromiferous iron are possessed by the artificially prepared chromite: density, insolubility in strong and boiling acids, colour, and metallic lustre. By calcining the mixture $\text{Cr}_2\text{O}_3, 2\text{FeO}$ with borax, the compound may be obtained crystallised in octahedra.

Liebig first obtained chloral in 1832 by the action of chlorine on alcohol. Two years later, M. Dumas established the exact composition of this body, and endeavoured to explain its formation. He was led to conclude that in the action of chlorine on alcohol, acetic ether is first formed, and that this ether afterwards produces chloral, by the substitution of 6 atoms of chlorine for 6 atoms of hydrogen. More recently still, M. Regnault, considering the formation of aldehyde in the first period of the action of chlorine on alcohol, supposed the chloral to result from the action of the chlorine on the aldehyde; and he considered this body as the trichlorinated aldehyde. This hypothesis, which made chloral from trichlorinated aldehyde, seemed confirmed by the transformation of this body into trichloroacetic acid effected by M. Kolbe. But on the other hand, when M. Wurtz demonstrated that, in the action of chlorine on aldehyde, chloride of acetyl is formed, from which chloral cannot be derived, this seemed altogether improbable. Professor Lieben, in 1863, investigated the action of chlorine on aqueous alcohol, and found that, in this case, the products formed are chiefly the chlorinated derivatives of acetal. He concluded from this that probably the chloral results from the decomposition of the trichlorinated acetal, under the influence of hydrochloric

acid, and he expressed the transformation of alcohol into chloral by a series of reactions, the result being in succession, aldehyde, acetal, monochlorinated acetal, bichlorinated acetal, trichlorinated acetal, chloral. Thus—



The discovery of M. Beilstein that aldehyde is obtained in treating acetal by acetic acid, and particularly the fact observed by M. Paterno of the production of bichlorinated aldehyde by means of bichlorinated acetal, are fresh arguments in favour of Lieben's theory. To demonstrate this theory completely, it was at the same time necessary to prove that trichlorinated acetal exists amongst the products resulting from the action of chlorine on alcohol, and that this body can be converted into chloral. This M. Paterno proposed to himself to verify by experiment.

Trichlorinated acetal, together with bichlorinated acetal, is obtained by the action of chlorine on alcohol at 80°. Water is added to the product, and the oil which collects at the bottom of the vessel washed with potash and distilled. Trichlorinated acetal is contained in the portions which pass over above 185°. To isolate it, these portions are distilled in a current of steam, the last quarter being collected separately; the portion thus separated is redistilled in the same way. After this operation has been repeated several times, the last portions being always separated, the steam commences to carry over a substance which crystallises upon reaching the receiver. This substance, compressed between folds of blotting paper, distilled, and crystallised from alcohol or ether, constitutes pure trichlorinated acetal. M. Paterno separated from 5 kilogrammes of alcohol, 10 grammes of trichlorinated acetal with difficulty, while he obtained at the same time nearly 1 kilogramme of bichlorinated acetal. Trichlorinated acetal crystallises in brilliant needles, resembling in aspect caffeine; it melts at 72°, and boils at 230°, decomposing a little. Alcohol and ether dissolve it easily. The following analytical results were obtained: Carbon, 32.10; hydrogen, 4.87; chlorine, 47.92; theory requiring 32.05, 4.96, and 48.05. When trichlorinated acetal is heated to 150° with ordinary sulphuric acid, a liquid, which appears to be identical with chloral, distils. But the quantity obtained was not sufficient to enable it to be purified for analysis. These experiments were made in the laboratory of the University of Palermo.

CHEMICAL SOCIETY.

Thursday, November 5, 1868.

DR. W. A. MILLER, V.P.R.S., &c., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed. Among the donations to the library which were announced was the valuable present made by Mrs. Warrington of eighty volumes from the library of her lamented husband, the late Professor Warrington. They consist chiefly of works which belong to the history of chemistry, and not the least important of them is a copy of Agricola's celebrated treatise "De re Metallica."

The following names of candidates for admission into the Society were read by the secretary:—For the first time—Mr. E. G. Tosh, Ph.D., Mr. G. R. Gowland; for the second time—Dr. W. J. Balmer, surgeon to the Bengal Army.

The CHAIRMAN, then addressing the Society, stated that the council had for some time been desirous of increasing the number of Fellows who took part in the business of the Society, but that they had met with some difficulty from the restrictions imposed upon them by the charter, which limited the number of the council to twelve. They found, however, that the charter did not define the number of the vice-presidents, and they therefore suggested that the list of vice-presidents should be increased by two.

For the purpose of discussing this proposal and altering the 5th and 7th by law, the chairman summoned the Fellows of the Society to a general meeting to be held on Thursday, November 19th, at eight o'clock.

The first paper read was by Mr. W. H. Perkin, "*On the Hydride of Butyro-Salicyl and Butyric-Coumaric Acid.*" This paper is published in full in the current number of the Society's journal, and we may therefore content ourselves with a brief abstract of it.

The author's previous communications had shown that hydride of aceto-salicyl, $\text{H}_2\text{C}_2\text{H}_3\text{O}_2\text{C}_6\text{H}_4\text{O}_2$, is an intermediate stage in the formation of coumarin from acetic anhydride and hydride of sodium-salicyl. By the substitution of other anhydrides for the acetic, he had obtained homologues of coumarin, and he now describes the hydride of butyro-salicyl, which forms the intermediate stage in the synthesis of butyric coumarin, as hydride of aceto-salicyl does in that of ordinary coumarin.

It is an oil boiling at $260^\circ\text{--}270^\circ\text{C}$. Hydrate of potassium decomposes it into hydride of potassium-salicyl and butyrate of potassium, and it yields with acetic anhydride a compound ($\text{C}_8\text{H}_8\text{O}_2\text{C}_6\text{H}_4\text{O}_2$) perfectly parallel with those produced by the action of the anhydride on the hydrides of ethyl-salicyl, aceto-salicyl, &c. When boiled with butyric anhydride and butyrate of sodium it yields butyric coumarin.

By the action of hydrate of potassium, butyric coumarin yields butyric-coumaric acid, a true homologue of ordinary coumaric acid, and like it capable of yielding only mono-metallic derivatives.

"*On the Application of Chlorine Gas to the Toughening and Refining of Gold,*" by F. B. Miller, F.C.S., Assayer in the Sydney branch of the Royal Mint.

The methods now in use for effecting the above purposes are all more or less unsatisfactory, and the author has therefore devised a process which appears to satisfy all the requirements of the case in a single operation.

A French clay crucible is saturated with borax by immersing it in a hot saturated solution, and drying. The gold is then melted in this crucible with a little borax, and a stream of chlorine gas is allowed to pass through it by means of a clay tube (a tobacco-pipe stem was found suitable). The chlorine generator is fitted with a safety tube 7 feet long, and is connected with the clay tube by a caoutchouc tube. In a few hours the whole of the silver is converted into chloride, which floats on the gold. The borax prevents the absorption of the chloride by the crucible, and also its volatilisation, except in very minute quantities. As soon as the gold has become solid, the still liquid chloride of silver is poured off, and the gold is now found to have a fineness of say 993 parts in 1,000. The apparent loss of gold is very little greater than is found in ordinary gold melting—being 2.9 parts in 10,000—whereas in the ordinary process it is 2. A small sample of the gold is removed from time to time during the operation by means of a piece of tobacco-pipe used as a pipette. This is rapidly assayed approximately, and thus the progress of the operation is judged of.

The fused chloride of silver obtained as a slab after the operation, is reduced by placing it between two plates of wrought-iron in a bath of dilute sulphuric acid. The spongy silver so obtained contains gold, which may be separated by nitric acid. The nitrate of silver can of course be precipitated as chloride, and subsequently reduced. The gold appears to be present in the chloride of silver in the form of a double chloride, and the author has succeeded in separating it directly from this combination by precipitation by metallic silver.

The CHAIRMAN, in proposing a vote of thanks to the author, remarked upon the great importance of the new process. Much of the gold imported into this country contained 60 or 70 ounces of silver in 1,000, which could not at the present time be profitably extracted. The new method would probably be soon adopted by English assayers.

Mr. FORBES had listened to the reading of the paper with great pleasure. It had hitherto been supposed that the volatility of chloride of silver was too great to allow of such a method of separation being adopted, but the author's experiments seemed to leave no doubt that borax would prevent the volatilisation.

Professor FOSTER remarked that the action of borax in this case probably consisted in its shutting out the atmosphere. The chloride of silver could not evaporate without an atmosphere into which it could diffuse itself. Dr. Matthiessen, in some of his experiments, made use of fused paraffin for the same purpose—viz., to avoid evaporation.

"*Note on the Specific Gravity and Boiling-point of Chromyl Dichloride,*" by T. E. Thorpe, Dalton Scholar in the Laboratory of Owen's College, Manchester. The author prepared the liquid by distilling an intimate mixture of 10 parts sodium chloride and 12 parts potassium dichromate with 30 parts strong sulphuric acid. He removed the free chlorine by repeated distillation in an atmosphere of carbonic acid. The specific gravity of the liquid so obtained was, at a temperature of 25°C , 1.92. Walter, whose previous determination is quoted by the author, found 1.71, but this number is rendered impossible by the fact that the pure liquid sinks when dropped into strong sulphuric acid.

The boiling point, at a pressure of 733 millimetres, was found to be 116.8° . Walter, at a pressure of 760 millimetres, found 118° . Allowing for the difference of pressure, these two observations agree completely. The dichloride cannot, however, be distilled without some slight decomposition.

"*Analysis of the Ashes of a Diseased Orange Tree (Citrus Aurantium),*" by T. E. Thorpe.

The orange plantations along the south-eastern coast of Spain, and in the adjacent Balearic Isles, have recently been visited with a severe epidemic, the rapid progress of which was naturally viewed with no little anxiety by the people, since the culture and exportation of oranges constitute one of their principal industries. The origin of the disease is involved in complete obscurity, and as yet it has baffled all attempts at remedial measures. The first symptoms are observed in the leaves, which turn yellow and drop off; a most disgusting odour exhales from the roots, and in a few days the tree succumbs. The violence of the disease is now, happily, much abated, and it appears to be dying out.

Professor Bunsen, who visited the Balearic Isles during the summer vacation of last year, collected specimens of various parts of the diseased plants, and the author has analysed the ashes of them under his direction in the laboratory of the University of Heidelberg.

The method of analysis is first described. The caustic bases were first converted into carbonates by treatment with CO_2 in a stoppered glass cylinder, the whole evaporated to dryness, treated with a small quantity of water, and the insoluble separated from the soluble portion by means of a weighed filter. Separate analyses of each were made. The phosphoric acid in the insoluble portion was estimated by means of tin. The highly concentrated nitric acid solution was treated with fuming nitric acid, warmed, and digested with tin foil till the latter was fully oxidised. On filtration, the whole of the phosphoric acid remained in the precipitate. This precipitate was dissolved in concentrated potash solution, diluted, saturated with sulphuretted hydrogen, treated with very slight excess of acetic acid, and the tin sulphide filtered off by means of Bunsen's filter-pump, the use of which is absolutely necessary. The filtrate was concentrated, filtered from the tin sulphide which had precipitated during evaporation, and the phosphoric acid thrown down in the usual way. The filtrate from the tin oxide was treated with sulphuretted hydrogen to remove foreign metals, such as

lead and copper, introduced by the tin, and the remaining metals determined in the usual manner.

The portion soluble in water was introduced into a weighed flask with a lateral tube by which aliquot parts of the weighed liquid could be removed for separate processes. The only one of these which presents any peculiarity is the process to which the platino-chloride of sodium was subjected. It was found impossible to remove all traces of magnesium from the alkaline chlorides by the use of ammonium carbonate and ammonia. The filtrate from the platino-chloride of potassium was therefore exposed to direct sunlight in a flask filled with hydrogen, the alcohol having been previously removed by evaporation. The platinum is quickly reduced, and the magnesium can then be estimated in the usual way.

We have no space for the details of the analyses which follow. Tables are given which show the percentage composition of the ash of the roots, stem, branches, and fruit, and the results are compared with the analyses of the ash of healthy plants made by Rowney and How, and by Dr. Richardson. The most remarkable differences observed in the comparison are shown in the following table, showing the percentages of lime and phosphoric acid:—

	Lime.	Phosphoric Acid.
Root of diseased plant.....	61.82	1.57
Stem of ditto	70.67	2.66
Root of healthy plant	49.89	13.47
Stem of ditto.....	55.13	17.09

The phosphoric acid is thus shown to be in deficiency in the diseased plant, and the lime in excess. Similar differences cannot, however, be traced in the ash of the fruit.

Professor WILLIAMSON asked whether any fellows present had tried the use of tin in separating phosphoric acid. Considerable doubts had been entertained as to its value.

Mr. DAVID FORBES had found the results obtained by the use of tin most unsatisfactory. Some oxides, especially that of iron, went down with the tin, and the whole of the phosphoric acid was not precipitated.

Professor VOELCKER had also tried the tin process but could make nothing of it. With reference to the question of the composition of the ashes of plants in disease, he remarked that we wanted data as to the composition of plants grown under different circumstances. The composition in health varied extremely with the nature of the soil, &c. Potatoes, for instance, exhibited the greatest variations of composition in different samples. In the determination of lime, it was not uncommon to find differences of from 10 to 18 per cent, and this in healthy plants. The speaker considered that too much reliance must not be placed on comparisons of this sort.

Dr. ATTFIELD had made many analyses of the ashes of healthy and diseased potatoes and other members of the genus *Solanum*, and had been unable to observe any constant differences of composition.

Dr. ODLING remarked that the differences in the percentages of lime recorded by Mr. Thorpe might be explained in the manner suggested by Professor Voelcker, but that the variations in phosphoric acid, supposing the analyses to be correct, were startling.

Professor WILLIAMSON: With different methods of analysis, chemists seem to get very different results. (Laughter.)

The CHAIRMAN enquired whether any of the Fellows had obtained good results with the molybdate process.

Mr. FORBES believed it to be the most accurate which had yet been suggested. It was necessary to take some precautions, in particular to allow the liquid to stand for a long time—25 to 30 hours—so as to become crystalline, before filtering it.

Professor MILLER and Dr. PAUL had both experienced great difficulty in washing the precipitate.

Professor VOELCKER found that if silica was present in the solution, it went down with the molybdate, and was subsequently dissolved by the ammonia.

The Society then adjourned until Thursday, the 19th inst., when, in accordance with the President's summons, a general meeting will be held at eight o'clock.

Thursday, November 19, 1868.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

IN accordance with the notice given at the last meeting, an extraordinary general meeting of the society took place at eight o'clock.

The PRESIDENT, in introducing the business of the special meeting, observed that it was convened under the provisions of Law 13, which permitted the convocation of such a meeting when any question arose which required the concurrence of the entire society. Their object on the present occasion was to discuss certain proposed alterations in the bye-laws, by which a greater number of Fellows would be admitted to a share in the government of the society. The council had long felt anxious to effect this object, and finding that the charter did not permit them to increase the number of the council, they now proposed to raise the number of vice-presidents who had not filled the chair, from four to six. This alteration would, it was felt, infuse some new blood into the governing body.

Formal alterations in the bye-laws to provide for the proposed change were then put to the meeting by the President, and were carried unanimously.

The meeting was then resolved into an ordinary one.

After the formal business, the following certificates were read:—

For the first time, Mr. W. W. Stoddart, Mr. John Hughes, Mr. T. Rowan; for the second time, Mr. E. J. Tosh, Mr. G. Gowland; for the third time, Dr. W. J. Balmer, Calcutta.

The last-named gentleman was then balloted for, and was declared duly elected.

The PRESIDENT then announced that a change in the arrangements for the meetings had become necessary. He had just returned from witnessing the demolition going on in Paris to find himself in similar quarters here. The arrangements with the Royal Society had, as the Fellows were aware, fallen through, and their pleasant tea after meeting was no longer possible. The Linnean Society had kindly accommodated them for that evening, and care would be taken to make fresh arrangements for next meeting.

Mr. W. H. PERKIN then made a communication "*On the Action of Chloride of Lime on Aniline.*"

About twelve years since the author, when experimenting upon the process of converting aniline into aniline purple by means of a salt of aniline and a bichromate, also made experiments upon Runge's well-known reaction for aniline, to see if the colour of the solution obtained in this manner was due to aniline purple or not; his results, however, were decidedly in the negative. But two or three years after the French manufacturers began to experiment upon aniline purple, and succeeded in obtaining it by employing chloride of lime as the oxidising agent.

These opposite results could not at the time be accounted for, but upon repeating his experiments lately the author has found his conclusions to be perfectly correct.

Reference was made to the name Runge first gave to aniline, which it will be remembered was kyanol or blue oil, on account of the blue or blue-violet colouration it gave with chloride of lime; and by performing Runge's experiment it was shown that an indigo-coloured fluid is obtained, appearing rather dull, because slightly turbid; it may be rendered perfectly clear by the addition of alcohol, and then presents, by transmitted light, a brilliant colour not unlike ammoniacal sulphate of copper and not at all like aniline purple. Moreover, silk immersed in the coloured fluid obtained by this reaction is dyed a dull blue-lavender shade.

Experiments were made to isolate this colouring of Runge's, and were tolerably successful, so that it was obtained in a

solid condition, and was found to dissolve in cold alcohol with a blue colour, and when evaporated spontaneously left the colouring matter as a solid, possessing a coppery coloured surface.

This colouring matter the author proposes to designate as "Runge's blue." It appears to be the salt of an organic base differing entirely in its behaviour with caustic alkali from a salt of mauveine, as its alcoholic solution gives with potash a pale reddish brown colour, a salt of mauveine producing under the same circumstances a solution of a violet colour.

Runge's blue dyes silk a blue or blue-violet shade, but does not take on to the fibre so readily as aniline purple.

The question as to how the manufacturer produces aniline purple by oxidising aniline with chloride of lime, seeing the result of that oxidation is the formation of Runge's blue, was next considered, and shown to be the result of proceeding a step further.

It is found that Runge's blue when boiled with water acidulated with acetic acid, is entirely decomposed, yielding aniline purple, and this is the additional step taken by the manufacturer. He boils his product with water acidulated with acetic acid for the purpose of extracting the aniline purple, but by performing this operation he not only gets his colour in solution, but actually forms it.

To show that this is not a process of purification, silk was dyed with Runge's blue, and in paste exposed to the action of steam for a few moments, when it was seen that the parts subjected to the action of steam were changed from a blue or blue-violet to the ordinary shade of aniline purple. A similar effect is also produced by the influence of heat alone.

An alcoholic solution of Runge's blue was found to be very rapidly decomposed into aniline purple by boiling, and by adding a few drops of sulphuric acid to the boiled product; crystals of sulphate of mauveine were deposited on cooling.

The same decomposition also takes place in the cold in the course of a day or two. This colouring matter does not appear to decompose so rapidly when in the solid state and when applied to silk its decomposition into aniline purple takes place very slowly. The instability of this substance has prevented the author from establishing its formula.

From the above results it was clearly shown that the colouring matter obtained by Runge is an entirely different substance to aniline purple, but that it is capable of yielding it when decomposed by heat.

Mr. Perkin also exhibited some beautiful specimens of benzoic and phthalic acids obtained from naphthaline, and also chloroxynaphthalic acid and some of its coloured salts which are manufactured on the large scale by Messrs. Depouilly, Frères, of Paris.

The PRESIDENT could not avoid recalling the time when he first saw Dr. Hofmann perform Runge's experiment of treating aniline with chloride of lime. He remembered saying to him, "Now, Hofmann, if you can fix that colour there is a fortune for you." It appeared, however, that it was not the right colour after all. The colour exhibited by Mr. Perkin seemed to offer an advantage to ladies who were fond of frequent changes in their costume. A lady would merely have to stand near the fire in a ball-room and her lavende silk dress would soon become a purple one.

Dr. MULLER enquired whether Mr. Perkin had made any experiments upon the oil which Marignac obtained by the action of potash on chloride of chloronaphthaline. This substance was very much like chloropicrin, though of course different from it. It would be very interesting to ascertain by comparative experiments whether the formula now given was correct. The action of nascent hydrogen upon it should likewise be studied, for it ought, under these circumstances, to yield methylene-diamine.

Mr. PERKIN had made no experiments in the direction indicated.

Dr. ODLING remarked that it would confer a great benefit upon science if chemists would follow the example of Mr. Perkin and publish the results of their repetitions of previously published, but little known, processes. The primary object of the society was, of course, the publication of new discoveries, but the immense number of the new processes which were published, rendered it impossible to repeat them all, and hence the records of confirmatory experiments were of the greatest value.

The PRESIDENT enquired whether any of the chloro-oxy-naphthalates exhibited, some of which, and particularly the zinc and copper salts, had a very beautiful colour, had been tried as colours.

Mr. PERKIN said they had, and had been found to be very stable. This observation was confirmed by Dr. Müller, who stated that the great objection to their use arose upon the score of expense. The President suggested that this would probably be only a temporary difficulty.

"Analysis of a Meteorite from South Africa," by Professor Church.

The meteorite in question was seen by a native to fall at Daniel's Knill, a place about two days' journey N.N.E. of Grigua Town. The native said that it was warm and smelt of sulphur when he picked it up. He offered it to the Rev. James Good, a missionary in Grigua Town, who declined it, and recommended him to take it back to the place where he found it! Instead of doing so, he gave it to a Grigua chief, Captain Nicolas Waterboer, and from his hands it passed into those of Mr. J. R. Gregory, of Russell Street, Covent Garden, and is now in the British Museum.

It was small in size, of an irregular oblong form, weighing 2 lbs. 5 ozs. It was covered with a dark grey crust, speckled here and there with reddish brown spots, these spots arising from a partial oxidation of the ferruginous materials of the stone. Its density was rather low, namely 3.657 and 3.678, as found in two determinations; but it is probable that the iron contained in the stone is in larger proportion in some parts than in those analysed, and therefore, were the density of the whole meteorite to be taken, it would very likely be as high as 3.8, or thereabouts.

The following was given as the analysis of the meteorite:—

Nickel-iron containing 5.18 per cent nickel.....	29.72
Troilite, FeS.....	6.02
Schreibersite.....	1.59
Silica and Silicates, chiefly olivine and labradorite.....	61.53
Carbon, oxygen, other constituents, and loss.....	1.14

100.00

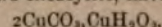
The iron-nickel was dissolved out of the stone by long digestion with dilute hydrochloric acid, the two metals being separated by the barium carbonate process. The sulphur was determined by oxidising the troilite with potassium chlorate, and nitric acid.

The schreibersite, a somewhat undetermined species, was approximately estimated by multiplying the unoxidised phosphorus in the stone by ten.

The composition of the meteorite was not quite uniform, one fragment yielding 39.2 per cent of nickel iron, and another only 48.99 per cent of silicates.

"On the Action of Salt on Chessylite," by Professor Church.

The author had, in 1864, commenced a series of experiments with the view of elucidating the formation of atacamite by the action of sea water on copper ores. The following was the only really successful experiment: 2 grammes of very pure chessylite, having the composition—



and a very pale blue colour, were immersed in 200 c.c. of a 10 per cent solution of pure salt. The blue colour slowly

changed to pale green, and by October of the present year the whole of the CO_2 of the mineral had been displaced by chlorine, and remained in the solution in the form of sodium carbonate. The mineral was now found to have the formula $2\text{CuCl}_2 \cdot 9\text{CuH}_2\text{O}_2 \cdot 3\text{aq}$. It was, therefore, analogous to atacamite, though it did not exactly correspond with it in composition. The water which it contained was not given off at 100° .

The PRESIDENT remarked on the length of time required for the completion of experiments of this kind. With respect to the meteorite he enquired whether the carbon found could be assigned to any other constituent, or whether it existed in the form of graphite.

Dr. MÜLLER enquired whether a direct determination of the carbon had been made. The absence of carbon in meteorites was so general that many were rejected because they were found to contain that element. He believed, however, that a few undoubted instances of its occurrence were known.

Professor CHURCH pointed out that the minute quantity of carbon present, not exceeding .1 per cent, together with the smallness of the fragments at his command, had precluded him from estimating its quantity. He had only been able to ascertain its presence qualitatively.

The PRESIDENT reminded Dr. Müller that he had seen at his house a meteorite, the fall of which, at Montauban in the centre of France, had been witnessed. It contained a very notable proportion of carbon, and others of a similar kind had since been traced. It was evident that the presence of carbon afforded no reason for doubting the meteoric origin of iron. Meteorites from different regions of space might have very different compositions, which made it the more remarkable, that no new element had ever been obtained from one.

Dr. MÜLLER endorsed the observations of the President, and added that distinct traces of a hydrocarbon had been found in one instance.

The PRESIDENT then described briefly some experiments which he had recently seen at the house of his friend Mr. Gassiot with a battery of 3,600 elements of zinc and carbon charged with mercuric chloride. This battery was able to transmit the current through vacuum tubes without the interposition of a coil. He took the opportunity of testing the electro-motive force of the arrangement in order to compare it with that recently suggested by Dr. Hugo Müller and himself. The latter instrument compared very favourably with the far larger one of Mr. Gassiot.

The Society then adjourned until Thursday, the 3rd of December.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 3rd, 1868.

J. P. JOULE, LL.D., F.R.S., &c., President, in the Chair.

"Remarks on Mr. Baxendell's Laws of Atmospheric Ozone," by Professor W. STANLEY JEVONS, M.A.

In reading the remarks of Mr. Baxendell on atmospheric ozone, it occurs to me that a very simple explanation can be given of the connection he detects between the height of the clouds and the amount of ozone at the surface, two facts which seem at first sight entirely unrelated. The quantity of ozone which reaches the surface will depend on three circumstances:—

1. The thickness of the current of air touching the surface.
2. The proportion of ozone existing therein.
3. The degree in which this current is rendered uniform by constant mixture.

The balloon observations of Mr. Glaisher proved what was previously inferred by meteorologists, that the atmosphere usually consists of several strata of air which are separated by distinct boundaries, and do not freely mix. Hence it is only the ozone in the lowest stratum which is

usually available at the surface, and its quantity will be proportioned *ceteris paribus*, to the thickness of that stratum. It is the height of the first layer of clouds which usually defines the upper limit of this stratum. For during my own observations, both in Australia and England, I have often noticed that smoke from a great town or from extensive bush fires rises only to a definite height, and seems to form the basis, as it were, of the cumulous clouds, which are the upward terminations of ascending currents. Now, as in May, the height of this stratum, according to Mr. Crosthwaite's observations, greater than in any other month, there will be a larger mass of air which can successively come in contact with the surface and furnish ozone. But we shall only have the full benefit of this ozone when an active process of mixture is going on. At night the air in contact with the earth is cooler than that above, and therefore tends to lie in a stagnant layer which can often be detected by the mist or smoke which it contains. This layer will be rapidly exhausted of ozone, and will be filled with the organic exhalations from the earth. Hence arises the comparatively unhealthy character, and in some climates the poisonous nature of night air, and it may constantly be observed that a moderate wind may be blowing above our heads, as shown by the motions of the clouds or the wind felt on a mountain top, without breaking up the stagnant layer on the surface. This is one reason why the air is calmer at night than in the day. But during high winds the gusts penetrate to the surface and prevent any stagnation, so that, as I apprehend, during stormy weather the deficiency of ozone in the evening would not be observed.

In the daytime, on the contrary, the sun's heat occasions a perpetual circulation or convection in the lowest mass of air up to the level of the cumuli. Every portion of the air is thus successively brought to the surface and organic substances are carried off and oxidated.

During my own observations on ozone I felt strongly the imperfections of the method of measurement alluded to by Mr. Baxendell, and I thoroughly agree with him that the mysterious variations of ozone will not be understood until not only the quantity of air brought into contact with the paper be measured or regulated, but the varying source and magnitude of supply be considered.

Mr. E. BOWMAN, M.A., exhibited and explained Mr. Barrett's modification of Professor Wheatstone's Kaleidophone.

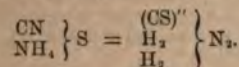
Professor H. E. ROSCOE, F.R.S., drew attention to the important discovery, made independently by M. Janssen at Guntoor in India, and by Mr. Norman Lockyer in London, of the visibility of the spectral lines of the red solar prominences under ordinary circumstances. Hitherto these protuberances or red flames have only been seen during total eclipses of the sun; but by the application of the spectroscopic in conjunction with the telescope, the peculiar bright lines which these prominences exhibit, indicative of the presence of glowing gas, can now be observed whenever the sun is visible. Although the priority of this interesting discovery is due to M. Janssen, who first observed the protuberances the day after the eclipse, the method having occurred to him whilst observing during the eclipse, yet Mr. Lockyer had suggested this particular method of examination no less than two years ago, and had succeeded in his endeavour before he became aware of M. Janssen's prior observations. From the accounts as far as they are yet published, we learn that the bright lines appear to be identical with those of hydrogen.

Mr. BAXENDELL stated that this discovery would give a great impetus to the progress of our knowledge of solar phenomena, and that the importance of observations on this plan could not be over-estimated.

Professor H. E. ROSCOE, F.R.S., exhibited and explained Carré's apparatus for freezing water by its own evaporation, and by means of which a pint of water was frozen in a few minutes.

DUBLIN SCIENTIFIC CLUB.

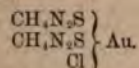
THE ordinary meeting of this club was held in the Lecture Theatre of the Royal Dublin Society. Professor Ball gave a communication "On Lord Rosse's New Drawing of the Nebula in Orion." Mr. Tichborne gave a verbal description of an "Anomalous Reaction observed in connection with Nitrates present in Well Water." Other communications were received as follows:—Mr. Thornton "On Peculiar Nodules in Sandstone;" Mr. Yeates, "On Sprengel's Air Pumps;" Mr. Johnstone Stoney, "On Huggins's Researches on Sidereal Astronomy" (see *Proceedings of Royal Society*, No. 105); Dr. Emerson Reynolds, "On Schönbein's Test for Prussic Acid." The same gentleman gave a verbal description of some experiments, which he shortly intends to publish, viz., "On the Isolation of Sulphur Urea" (sulphocarbamide). Dr. Reynolds seems to have formed this substance, which hitherto has not been known in an isolated condition. In his investigation in connection with sulphocyanide of ammonium, which has extended over some considerable time, he found that on heating that substance for some time to its melting point, and then extracting with alcohol, he obtained a white crystallisable substance, which, on analysis, answered to the formula of sulphur urea:—



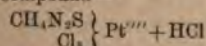
The cause of failure in forming this substance must have been from the fact that sulphocyanide of ammonium was either heated to too high or to too low a temperature.

The following compounds were also described:—

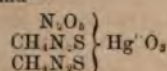
1. Gold compound—



2. Platinum compound—



3. Mercurial compound—



GLASGOW PHILOSOPHICAL SOCIETY.

CHEMICAL SECTION.

THE opening meeting of the session took place in the Society's rooms, Andersonian Buildings, on Monday, the 9th inst.

Dr. ANDERSON, the President, delivered an address on "The Present Aspects of Chemistry, and its Relations to the Arts." In the course of his remarks he referred more particularly to the modern theories relating to chemical changes, and discussed at some length the views of Sir Benjamin Brodie, as set forth in his "Calculus of Chemical Operations." He also alluded to the progress of chemical science on the Continent, and contrasted the splendid new laboratories now being established in Germany, with the comparatively indifferent facilities at present existing in this country for the prosecution of chemical study and research. He also drew attention to the fact that many of the manufactures successfully carried on on the Continent appeared to be impracticable in England, and referred this circumstance to the superior technical training and skill of continental workmen.

A vote of thanks was given to Dr. Anderson for his appropriate and interesting address.

The Annual General Meeting was held in the Society's Rooms, Andersonian University Buildings, on Monday evening, the 23rd inst.

The following gentlemen were elected office bearers:—

President—

Thomas Anderson, M.D., F.R.S.E., Professor of Chemistry in the University of Glasgow.

Vice-Presidents—

Dr. Wm. Wallace, F.R.S.E.

Alexander Whitelaw.

Treasurer—

William R. Hutton.

Secretary—

Robert R. Tatlock, F.C.S.

Council—

James H. Bald.

James Cowper.

John Ferguson, M.A.

John Jex Long,

William Macadam.

James Mactear.

John Paynter,

Edward C. C. Stanford, F.C.S.

Mr. JAMES MACTEAR, F.C.S., gave an interesting description of Gay Lussac's apparatus for absorbing the waste nitrous gases of vitriol chambers, and experimented very successfully with a working model of the arrangement. He afterwards detailed the various methods used for denitrating the nitro-sulphuric acid produced. In answer to an enquiry, Mr. Mactear stated that the question, whether the vitriol manufacture is more economically conducted with or without the adjunct of the "Gay Lussac" depends upon the market price of nitrate of soda, and other circumstances.

Mr. BALD afterwards exhibited some efflorescent and deliquescent crystals, preserved by a coating of paraffin.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

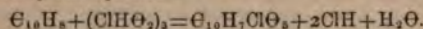
Ketone of Formic Acid.—E. Mulder. Assuming the ketone of formic acid to be identical with formic aldehyd, this interesting compound may be expected to be formed by that reaction which is used for the preparation of ketones when applied to formic acid. On heating calcic formiate and condensing the products of distillation at a very low temperature, a liquid was obtained which had all the properties of Hofmann's formic aldehyd.—(*Zeitschr. Ch., N.F.* iv., 265.)

Estimation of Cobalt in Presence of Arsenic.—C. Winkler. The method for the volumetric determination of cobalt in presence of nickel, as proposed by the author some years ago (*Z. Anal. Chem.*, iii., 265, 420), was found to be inapplicable in cases where oxygen compounds of chlorine, sulphur, arsenic, and phosphorus were present. The method consisted in first mixing with the solution to be tested mercuric oxide, and then adding a standard solution of potassic permanganate. The injurious action of arsenic and phosphoric acid may, however, be easily avoided by precipitating them as arseniates and phosphates of iron, by adding a proportionate quantity of pure ferric chloride, an excess of which is removed from the solution by the subsequent addition of mercuric oxide. Sulphuric acid is removed by means of baric chloride. The solution does not require to be filtered before titration.—(*Z. Anal. Chem.*, vii., 47.)

Gliding Glass.—W. Wernicke. The following are the ingredients required:—1st. Solution of gold: pure gold (free from silver) is dissolved in aqua regia, the solution evaporated, and the residue taken up with water, so that 120 c.c. contain 1 gramme of gold. 2nd. Solution of sodic hydrate (which need not be absolutely pure) of 1.06 sp. gr. 3rd. Reducing liquid: 50 grammes sulphuric acid (monohydrate), 40 grammes alcohol, 35 grammes water, and 50 grammes powdered manganic peroxide, are distilled into 50 grammes water until the bulk of the latter is doubled—10 grammes cane sugar, inverted by dissolving in 70 c.c. water and boiling with 0.5 grammes nitric acid of sp. gr. 1.34. The distilled liquid, the inverted sugar, and 100 c.c. alcohol are mixed together, and the mixture diluted to 500 c.c.

In using these solutions 1 volume of the sodic hydrate solution is mixed with 4 volumes of the gold solution, and to this mixture is added from 1-35th to 1-30th volume of the reducing liquid. The object to be gilded is placed on the top of the solution, having the surface intended to be coated turned downwards. The temperature of the bath should be below 60° C. Glass surfaces must be cleaned with a solution of sodic hydrate and alcohol; cleaning with acids would prevent the film of gold from adhering firmly.—(*Pogg. Ann.*, cxxxiii., 183.)

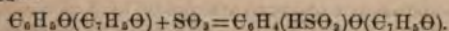
Chlorous Acid and Naphthalene.—Th. Hermann. On adding potassic chlorate to a mixture of moderately concentrated sulphuric acid and naphthalene, chlorous acid is generated, which, acting upon the naphthalene, causes the formation of various products of addition, substitution, and oxidation; of the last are phthalic acid and carbonic anhydride. As a product of addition an acid of the composition $\text{C}_{10}\text{H}_7\text{ClO}_3$ is obtained, the formation of which being represented by the equation—



This acid is soluble in water, and on evaporating the solution separates in oily drops. It is gradually decomposed by water, more readily by baric hydrate, chlorine being substituted by hydroxyle, and a new dibasic acid formed. The latter acid, which is amorphous like the former, is readily soluble in water, reduces an ammoniacal silver solution, and forms a soluble precipitate with plumbic acetate.

Further products of the reaction are dichloronaphthalene, which is obtained in large quantities, and a sulphosacid which is obtained as a potassic salt of the composition $\text{C}_{10}\text{H}_4\text{KClSO}_4$. This salt crystallises in small brown crystals which dissolve in water, producing a dark red solution. When subjected to dry distillation naphthoquinone, besides other compounds, is formed.—(*Sitzungs. d. Ges. z. Bef. d. ges. Naturw.* z., Marburg, 1868, 48).

Benzoyl-Paraphenolsulphuric Acid.—A. Engelhard and P. Latschinow. The action of sulphuric anhydride upon phenylic benzoate gives rise to the formation of various compounds, according to the conditions of the experiment. At 0° C., benzoylparaphenolsulphuric acid is principally formed—

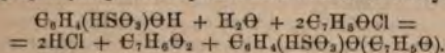


If the reaction is allowed to continue, another acid, of the composition $\text{C}_6\text{H}_3(\text{HSO}_2\text{O})_2\text{O}(\text{C}_7\text{H}_5\text{O})$,—or, perhaps, $\text{C}_6\text{H}_3(\text{HSO}_2\text{O})_2\text{O}[\text{C}_7\text{H}_4(\text{HSO}_2\text{O})]$, i. e. benzoyle-sulphophenoldisulphuric acid—makes its appearance.

At ordinary temperatures and with an excess of sulphuric anhydride, an energetic reaction takes place, accompanied by a rise of temperature and benzosulphuric together with phenoldisulphuric acid are obtained—

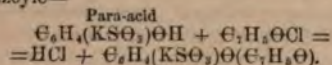
$\text{C}_6\text{H}_5\text{O}(\text{C}_7\text{H}_5\text{O}) + 3\text{SO}_3 = \text{C}_6\text{H}_5\text{O}(\text{C}_7\text{H}_5\text{O})_3\text{SO}_3$, or more probably = $\text{C}_6\text{H}_4(\text{HSO}_2\text{O})_2\text{O} + \text{C}_7\text{H}_4(\text{SO}_2\text{O})_2$, i. e., phenoldisulphuric acid, and the anhydride of benzosulphuric acid. Benzoyle-paraphenolsulphuric acid is easily separated from those accompanying it by being converted into the baric salt, which is almost insoluble in water, while the corresponding salts of the other acids are readily soluble.

Another method for the preparation of this acid consists in acting upon paraphenolsulphuric acid with chlorbenzoyl—

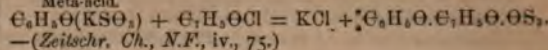


The reaction which sets in at once has to be assisted by gently heating the mixture; the acid is then extracted with cold water.

The authors confirm Kekulé's statement as to the existence of two isomeric sulphoacids of phenol. The potassic salts of para- and meta-phenolsulphuric acid are differently acted upon by chlorbenzoyl—



Meta-acid.



NOTICES OF BOOKS.

Braithwaite's Retrospect of Medicine. Vol. 57. Simpkin and Marshall.

LIKE the previous volumes this fifty-seventh half-yearly retrospect of medicine is invaluable to the busy practitioner. As we write the word "practitioner," we are struck that a learned profession should endure a designation so uncouth and ear-offending. If one, never having heard of the ambiguous title "general practitioner" as applied to a doctor practising both medicine and surgery, were asked the probable application of this equivocal designation, he would inevitably connect it with a breaker of the law not very particular in his predatory range from handkerchiefs to housebreaking. Besides the titles of doctor or physician and surgeon, a middle term is required to denote the bulk of the medical profession, who combine the practise of both medicine and surgery. If no single word is available, surely physician-surgeon or surgeon-physician would more fitly designate one who practises both branches of his profession than the nondescript, ill-sounding title, "general practitioner."

Throughout this volume, as in the more recent volumes, there are manifold indications of the deepening conviction that zymotic diseases are caused by the action of various kinds of infusoria, and that ultimately some chemical means will be discovered capable of destroying them in the human economy. Of considerable interest to the pharmaceutical chemist are two papers by Dr. Sansom, who strives to show with a noteworthy array of facts, which at a future time he promises to strengthen, that a combination of sulphites with carbolic acid has proved remarkably efficacious in the treatment of cholera, small-pox, scarlatina, &c. He has succeeded in making compound salts of sulphuric and carbolic acids with potash, ammonia, soda, and magnesia. Who can gainsay the reasonable expectation that chemistry will one day yield an antidote as potent against zymotic diseases as quinine is against ague?

Sanitary Siftings, or Results of Sewage Systems Compared. London: E. and F. N. Spon, Charing Cross.

The A.B.C. Sewage Process. London: Yates and Alexander, 7, Symonds Inn, Chancery Lane.

Report on the Sewage of the City of Melbourne. By SIDNEY GIBBONS, F.C.S., F.R.M.S., &c.

THE numbers of a community may be limited by two causes—(1) by bad sanitary arrangements; (2) by the insufficiency of food to support an increase. Such is the general statement with which the writer of the first pamphlet starts. The disposal of excrementitious matter is considered, and doubtless truly, as closely connected with pure air and water, and thus as the all-important question.

Of the schemes already proposed at different times that of filtration is first considered, and dismissed as useless. In connection with the precipitation of sewage we find the following:—

"As the alchemist of olden time passed his life in the vain pursuit of the philosopher's stone or the elixir vitae, so in the present age the resources of chemistry have been wasted in the endeavour to extract wealth by precipitation into a portable and concentrated manure of the valuable parts of sewage." That many of the proposed plans have been complete failures is not to be denied, among others the process employed by the Patent Solid Sewage Manure Company at Leicester, and likewise the works carried on at Montfaucon in Paris. But the mention of Leicester brings to mind the experiments of Messrs. Sillar and Wigner; of these we shall have occasion to speak immediately. Even improvements

have been recently made in the mode of treating the refuse collected at Montfaucon.

Regarding the removal of sewage by water, among other proposed improvements noticed, is the flushing of the sewers with 42,000,000 gallons of water additional. It appears the water companies could only supply 5,000,000 additional. We scarcely agree with the writer in the remark, "Were it otherwise, water would not be a remedy, for the more water the more smell, as it supplies the hydrogen for forming the deadly sulphuretted hydrogen of sewage." However, the advantage for the dry method is that while water adds fermentation, earth destroys it. The opinions of several good authorities are favorable to the earth system; thus Lord Leigh says, "I have thought a great deal on the subject of these earth closets, and we have adopted the plan with a reformatory school in this neighbourhood, of which I am chairman, and used it with great success." It need scarcely be remarked that the value of the refuse matter as manure is greater when earth is used instead of water. Little is required, we are told, to establish the efficacy, feasibility, and cheapness of the earth system. Dr. Mount has borne testimony to the Government of India as to its very great value, and the reports of the Commission of Enquiry in India, showing, among other things, a great decrease of mortality in gaols and hospitals in that country, are most positive as to its efficacy. We believe that too little is known regarding earth closets, and we are at the same time aware that one authority on the sewage question has expressed himself somewhat favorably concerning them. The Government and Secretary of State for India awarded the Rev. Henry Moule £500, in token of their sense of the benefits conferred upon the inhabitants of India by his system.

In connection with the same subject, we have a description of Messrs. Sillar and Wigner's A.B.C. sewage process, and the experiments made at Leicester, Tottenham, and Leamington. The A.B.C. mixture derives its name from the initials of the three principal ingredients, animal charcoal, blood, and clay. When this compound is suspended in water and added to the sewage, a precipitate in large flakes is immediately produced; the supernatant liquor is drawn off into a tank and a small quantity of perchloride of iron solution added. The iron compound serves to remove the sulphuretted hydrogen. It has been found convenient to add a certain proportion of alum, since the process is thereby accelerated. The authors very naturally deplore that one of the most serious mishaps in connection with the arrangements at the Abbey Meadow Sewage Works at Leicester should have happened on one of the days when the samples were being taken by the Royal Commission. The dam between the tanks being washed away, about 150,000 gallons of sewage flowed into the tank containing the sewage under treatment by the A.B.C. process. "As an illustration of the injurious effects produced by the accident to the dam, an analysis marked with a star may be pointed out. This sample, which was taken during the visit of the Royal Commission, contained nearly as much sewage as purified water. It is not to be wondered at that it contains 18 grains per gallon of organic matter.

As to the value of the precipitate for agricultural purposes, we find that the material obtained from the Leicester experiments contained 4½ per cent of ammonia, and that a considerable quantity was sold on the London Exchange at 70s. per ton. The authors state that two independent analyses give valuations of £3 17s. 3d.; they enjoin the necessity of treating the residuum with acid before allowing to dry, so that the ammonia may be fixed, and remark, "Dr. Frankland's estimate of a sample allowed to dry without the necessary addition of acid, whereby a large portion of the ammonia was lost, is (even then) £1 13s. 0½d. per ton!"

The following results will enable a judgment to be formed upon the process:—

"1st. The sewage contained 43·02 grains per imperial gallon of organic matter. Of this the A.B.C. process precipitated 33·33 grains, leaving only 9·69 grains in the water, and

this from an average of fifty samples taken at intervals during the progress of the experiment.

"2nd. Hitherto the lime process has been acknowledged to be the best, and the Leicester mode of conducting it to be the best of its kind. The A.B.C. contrasts most favourably with this, inasmuch as from samples taken at the same time from each, the water contained as follows:—

"Water from the A.B.C. contained 9·69 grs. per imp. gall.
" " " lime " 16·18 "

having precipitated from the sewage the following proportions:—

"Organic matter precipitated by the A.B.C. 77·48 per cent
" " " lime " 62·39 "

"3rd. Of the nitrogen in the form of ammonia in the sewage, nearly all is dissipated by the lime process, but by the A.B.C. about 80 per cent was retained in the residuum.

"4th. Of the phosphates in the sewage, the lime process threw down 82 per cent, in a form unavailable, owing to the presence of lime; but the A.B.C. threw down the whole, and in a form readily available.

"5th. During the act of precipitation by the A.B.C. process there was no objectionable odour, whilst that from the lime was 'horribly offensive,' owing, of course, to the ammonia and other vapours being driven into the air by the lime.

"6th. The water from the A.B.C. is in no way detrimental to fish in the river. We have fish which have been for some weeks living in the purified sewage."

On the conclusion of the Leicester experiments, two smaller ones were made at Leamington with about 60,000 gallons of sewage.

A considerable number of analytical results are appended, from which we extract the following, as perhaps of most importance, since there seems to be no doubt whatever that the liquid after precipitation is not offensive, and the main question, therefore, we take it, is the manurial value of the precipitate:—

	Leicester residuum dried in bulk.	Leamington residuum.
Water.....	1379.....	676
Organic matter.....	4693.....	2942
Alkaline salts.....	497.....	1371
Earthy salts, containing } phosphoric acid = 1·31 }	12·88 = 1·17	23·83
Silica.....	2143.....	2628
	100'00	100'00
Nitrogen = Ammonia.....	467.....	379

According to Mr. Wigner's analysis, the residuum possesses considerable value as a manure; the authors expect that instead of the disposal of sewage being a heavy expense, it may be made a source of revenue. The question, in the case of most towns, will not be—Can the supernatant water be mixed with river water from which the supply is afterwards to be drawn? If such were the case, notwithstanding the small amount of organic matter remaining, objection might be urged as to the quality of this organic matter, and the quality of organic matter in water is very uncertain. Hence we are inclined to think that the process is of considerable value.

The Health Committee of the City Council, Melbourne, instructed Mr. Sidney Gibbons, F.C.S., to investigate the nature of Melbourne sewage, with particular regard to the efficacy of a certain filtration process. It may be necessary to inform our readers that Melbourne has no sewers. Up to the present time, cess-pits have been employed for the reception of excreta and refuse of all kinds; latterly urine and other liquid refuse matters have been poured into the street gutters, with flushing water. Mr. Gibbons explains in his report the fermentation which urine undergoes. The filter, which it was desired to know more about, contained animal charcoal; this filter was supposed to retain the solid excreta, and to so purify all the other matters that the liquid issuing

would be inoffensive. "The suspicion that it was chemically inoperative and mechanically incomplete was fully borne out."

The earth system, the merits of which we discussed in commencing, deserves the notice of the Melbourne Council; the conditions seem to us precisely suitable.

CORRESPONDENCE.

Artificial Manure.

To the Editor of the CHEMICAL NEWS.

SIR,—Although I perfectly agree with Mr. Little as to the necessity of doing something to put a stop to the large number of "quack" fertilisers now deluging the market, I must take exception to the way in which he seeks to carry his point. My counsel to him would be the same as Dr. Abernethy's (when sounded by a friend for a gratis opinion)—"Go, sir, and take advice." It appears to me, that to combine as a sort of co-operative society—1st, to obtain a given manure at a cheap rate; and 2nd, to get an opinion, or rather series of opinions, from our eminent men, by inaugurating a controversy on manures, into which many of our chemists will plunge eagerly—is not the most likely course to be of any ultimate service, although it may be a cheap one in the meantime. If the farmers of a county, or division of a county, would combine, and pay a retainer to a properly educated chemist, who would in return agree to reside amongst them, and give his services at some nominal fixed scale of fees, what an incalculable advantage it would be to them. A farmer would then be free to purchase any suitable manure for his crops in the cheapest market, and, by simply sending his samples to the Society's Laboratory, he would at once be advised what to use and what to shun. This would soon drive the "quacks" from the field, while the ordinary competition among manufacturers would keep the prices down by the usual rule of free trade.

I hold, therefore, that the true *panacea* is the appointment of a qualified chemist by every Chamber of Agriculture throughout Britain, and that thereafter no farmer should buy any artificial manure, except under his advice, deduced from actual analysis of the sample handed in by the trader, and confirmed by another analysis of a fair sample of the bulk delivered. In such a laboratory provision might also be made for the instruction of sons of members in the elements of agricultural chemistry, while to that branch of science itself, an impetus would be given by increasing the number of paying appointments, and so inducing many clever young men to study chemistry, who are at present kept out of our profession by their poverty, and by the almost utter hopelessness of living by it in after life. I trust, therefore, in conclusion, that the chemists of England will not, in justice to themselves, be induced to enter upon the discussion sought to be inaugurated until it is started not by the farmers, but by the chemists themselves who have been appointed as above proposed.

I should have liked to have said something on their "superphosphate" ideas, but, as that would be to enter upon the very discussion I deprecate, I must reserve my remarks for a better occasion.—I am, &c.,

JOHN MUTER.

New Kennington Institute,
November 2, 1868.

Ozone.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to your correspondent who has kindly noticed my few remarks on ozone observations (CHEMICAL NEWS, vol. xviii., p. 202, *American Repr.*, December, 1868, page 338), I beg to enclose the following rules:—

1. Use Schönbein's test-papers, as sold by Casella.

2. Expose them in the small-sized ozone cage (Sir James Clarke's) as made by Casella.

3. Give exact particulars as to the height, position, and surroundings of the cage.

4. Change the test-papers every twelve hours—at 9 a.m. and 9 p.m.

5. Use Schönbein's scale, at the same time note very carefully the different shades and modes of distribution of the colour over the test-paper (as, for instance, whether equally distributed or in specks or spots), with the view to the formation of a more perfect scale.

Should your correspondent succeed in organising a club such as he proposes, I shall be most happy to contribute, so far as I am able, observations on ozone.—I am, &c.,

R. C. C. LIPPINCOTT, jun., F.M.S.

Over Court, near Bristol,
Nov. 5, 1868.

Chemical Laboratories.

To the Editor of the CHEMICAL NEWS.

SIR,—It was with great pleasure that I read the article upon chemical laboratories which appeared in your last impression. (*American Repr.*, Jan. 1869, page 1.) Something of the kind has been long required to show how sadly we are in want of more chemical laboratories, and how altogether inadequate to our wants are the few poor and ill-furnished ones which we possess.

I trust that the writer will allow me to correct one statement of his which is likely to leave an erroneous impression upon the minds of many, viz., the following:—"The Schools of Mines had a very limited idea of its duties as regards chemistry when it gave only a corner for its exercise." Now this "small room in a corner," as he very aptly and strikingly describes it, is now no longer the chemical laboratory, although it may have been at a former time, but is used as the metallurgical laboratory. The reader may judge for himself whether the term "small room" is applicable or not when he is told that it contains benches for about eight students, and that more could not possibly be squeezed in.

At the present time there are about twelve gentlemen working, or rather endeavouring to work, in this place, besides others who are waiting to do so, so that the authorities cannot say more space is not required.

On the other hand, the extent of the chemical laboratories is somewhat greater, comprising, in fact, the Royal College of Chemistry, which affords accommodation for nearly 50 students. We thus see that the Royal School of Mines pays rather more attention to chemistry than one would suppose from the reference made to it in the paper to which allusion has already been made, although even that attention is nothing like sufficient.

Apologising for taking up so much valuable space, I am, &c.,

A. L.

Estimation of Free Hydrochloric Acid.

To the Editor of the CHEMICAL NEWS.

SIR,—In determining the amount of escape of hydrochloric acid in different alkali works, I frequently find it necessary to recognise and estimate the amount of this acid in a mixture which may contain sulphuric acid, hydrochloric acid, and chlorides.

As I have never found a satisfactory plan of doing this described in any of the books I have consulted, I give you the method I adopt, hoping it may be useful to other chemists. I first obtain an aqueous solution of the substance to be examined, if gas from a chimney or flue, by drawing through water by means of an aspirator; if a solid, by lixiviation with water. To this solution I add precipitated carbonate of baryta in a moist state, digest for a short time, boil to expel carbonic acid, and thus precipitate any carbonate of baryta held in solution, and filter.

The whole of the hydrochloric acid having by this process

been converted into chloride of barium, from the amount of baryta in the filtrate, the quantity of free hydrochloric acid in the original substance may be easily calculated.—I am, &c.,

JOHN T. HOBSON,
Inspector of Alkali Works, Middle District.
Lisgh, November 7, 1868.

Peridote Meteors.

To the Editor of the CHEMICAL NEWS.

SIR,—In your valuable journal of Nov. 6 (*American Repr.*, January 1869, page 35), you give the results of an analysis recently made by my friend Professor Pisani, of the meteoric stone that fell on the 11th of July, 1868, at Ormans (Doubs), which analysis shows as much as 75 per cent of peridotite silicate. M. Pisani has remarked on this occasion that the proportion of peridotite in this meteorite is much larger than in any other known.

I should be glad if you would allow me to observe that in my work "Meteors, Aërolites, and Falling Stars," published in London in 1867, which contains all the analyses of Meteoric stones made up to that date, I have given (p. 112 et seq.) a complete account of the fall, and two analyses of the remarkable meteorite which fell on the 3rd of October, 1815, at Chassigny, near Langres. This meteorite consists almost entirely of peridotite material. There is a small fragment of it in the collection of the British Museum. It does not appear to contain any iron or nickel in the metallic state, but to contain no less than about 96 per cent of ferruginous olivine; hence it belongs to the third section of my classification, viz., meteorites containing little or no metal.

This complete absence of metallic ingredients may perhaps account for the curious fact that when this stone fell no globe of fire was seen. It was observed to fall (at half-past eight in the morning), after a series of detonations, from a grey cloud above the north-east horizon, and penetrated about two feet deep into the soil of a vineyard; a thick smoke issuing from the ground indicated the spot where it fell.—I am, &c.,

T. L. PHIPSON, Ph.D., F.C.S.
The Cedars, Putney, S.W., 7th Nov. 1868.

Reversal of the Sodium-Spectrum.

To the Editor of the CHEMICAL NEWS.

SIR,—It may be worth while to record a reversal of the bright sodium line which I have observed in the spectrum of the mass of flame in a copper smelting furnace. This phenomenon, which it is not quite easy to realise experimentally, is most beautifully seen, and I have no doubt can be obtained as easily from any similar furnace.

The furnace is fired from one end and charged at the other, so that one end is much hotter than the other. On looking into the furnace from the hot end there is seen in the spectroscopic a continuous spectrum crossed by a bright sodium line, but on looking in from the cold end a continuous spectrum crossed by an intense dark line is seen. As the furnace becomes hotter the dark line disappears, and is replaced by the bright line; but before this has become permanent the bright and dark lines alternate as the flame flickers, and their exact coincidence can be observed.—I am, &c.,

W. MARSHALL WATTS.
Manchester Free Grammar School.

Peridote Meteors.

To the Editor of the CHEMICAL NEWS.

SIR,—I find in No. 467 of the CHEMICAL NEWS (*Am. Repr.*, Jan., '69, page 45), an interesting letter from Dr. Phipson, which contains, besides some very exact remarks, several assertions which late researches have contradicted.

It is true that M. Damour, in publishing the analysis of the meteorite of Chassigny, says that it contains no metallic iron whatever, and, he added, that this stone exercised no action on the magnetic needle. Nevertheless, experiments lately made at the laboratory of geology of the Museum of Paris, by M. Lawrence Smith—experiments which I have myself repeated and verified—have convinced me that a small quantity of metallic iron does exist in this meteorite.

Besides, without speaking of the stone of Chassigny, it must be remarked, in contradiction to the assertion made by M. Pisani, that many meteorites contain more than 50 per cent of peridotite, so that the composition of the stone of Ormans offers nothing particularly remarkable.

I will mention on this subject the meteorite of Sauguis (7th Sept. 1868), of which I lately published the analysis, and which contains more than 60 per cent of peridotite. I will remind you also of the stones of Luotalsak, of Braly-stock, and of Massing, which all contain more peridotite than that of Ormans.—I am, &c.,

STANISLAS MEUNIER.

Alde Naturaliste au Museum,
33 Rue de Vaugerard, Paris.

The A.B.C. Sewage Process.

To the Editor of the CHEMICAL NEWS.

SIR,—I see in your issue of the 6th inst. (*Am. Repr.*, Jan. '69, page 4), an article by Dr. Frankland, "On the Purification of Sewage," which appears to be a copy of his report to the chairman of the Royal Rivers Commission on the Leicester sewage experiments. Although these experiments were conducted under my superintendence, the first intimation I had of Dr. Frankland's report was in the public papers. I must, therefore, ask you to allow me space to reply to it in the same way.

The trial of the A.B.C. process was in the strictest sense of the word an "experiment." The plant perfectly adapted for the lime process was in several respects unsuitable for the new one. From this cause several accidents happened; one in particular, mentioned by Dr. Frankland, by which no less than 150,000 gallons of raw sewage were pumped into a tank holding 430,000 gallons of purified sewage. It was impossible to drive this out in less than six or seven hours, and I felt compelled to make a written protest against the samples being taken; nevertheless those from the latter half of the day are to our disadvantage included. From this reason the proportion of suspended matter contained in our effluent water of that day is 4.36 parts in 100,000, while that in the lime purified is 2.84; and it is necessary to bear in mind that by the same accident a portion of the A.B.C. mixture was admitted to the tank containing the lime purified sewage, from which it threw down a further precipitate. This fact is brought out singularly by the comparison of the lime purified water of May 13th with that of this date. Dr. Frankland notices the uniformity in the samples of sewage: the comparison may be shown as follows:—

	Suspended matter in sewage.	Suspended matter in lime purified sewage.
May 13th, 1868.....	22.12.....	16.80
July 31st, ".....	48.08.....	2.84

The A.B.C. process suffered during the whole week of the experiments from a continued leakage of the new compound into the lime tanks; during the last day this was at its minimum, and the proportion of suspended matter in the A.B.C. water was considerably less than half that in the lime; clearly, then, the new process has the advantage here. The question of additional solid matter is much modified by the fact that the residue from the lime purified water contains but little water of hydration, while that from the A.B.C. process (in which an excess of alum was too frequently present) contains much. Dried at 212°, as in Dr. Frankland's mode of water analysis, the lime process has a considerable advantage; dried at 302°, the excess is extr.

and even this would disappear as soon as the proportions were accurately adjusted to the sewage.

But the point which most surprises me is the statement that the purified sewage invariably contains more ammonia than the raw sewage. Dr. Frankland's explanation is partly right, but partly wrong. The A.B.C. compound has the power of slowly converting part of the organic matter dissolved in the water into ammonia, and if certain ingredients are present in excess, this action will go on for weeks, a slow precipitation of organic matter taking place at the same time. I found very early in my experiments on the subject that an ammonia determination in the effluent water was valueless, unless made within two or three hours; all but about ten of mine were so made at Leicester.

If Dr. Frankland's samples were not analysed for some days the explanation is clear. I may add that this action being gradual does not sensibly affect the suspended matter, but acts only on the dissolved impurities. Its effect must, I consider, be beneficial in enabling the remaining nitrogen to be more readily assimilated by the plants in the rivers. The A.B.C. process does, therefore, remove the larger part of the ammonia, although it subsequently produces a further quantity in the water, and a corroboration is found in the fact that, although the new process produces a much larger quantity of residue than the lime process, the percentage of ammonia in the residue is more than twice that in the lime.

Dr. Frankland expresses a doubt which I can easily remove as to the source of the phosphoric acid in the manure. During the whole experiments (10,000,000 gallons) 143 lbs. of phosphoric acid were used in the form of bone black. The actual quantity of manure made is not less than 80 tons at the lowest estimate (for all is not yet dry enough to weigh). 143 lbs. of phosphoric acid will be '080 per cent on this quantity, leaving 416 per cent as the quantity derived from the sewage.

I have noticed no points but Dr. Frankland's own figures and statements. The process will be at work in a few weeks on a large scale with works specially adapted for it, and capable of treating about 1,000,000 gallons per day. The real proof of the capabilities of the process will be in these works.—I am, &c.,

Camberwell, Nov. 16, 1868.

G. W. WIGNER.

Cohesion Figures.

To the Editor of the CHEMICAL NEWS.

SIR,—As I see that you refer to the production of Professor Tomlinson's beautiful cohesion figures of oil, &c., in the last number of the CHEMICAL NEWS (*Amer. Repr.*, Jan., '69, page 49), it may possibly interest your readers to know that these curious forms can be easily exhibited to a large audience. At the evening scientific meeting of this society, held on Monday, the 16th inst., I succeeded perfectly, with the aid of Mr. Yeates, the excellent optician of this city, in projecting the cohesion figures of oils of lavender, cod liver, and castor, and that of benzole, upon the ceiling. A beam of light from the oxyhydrogen lamp was thrown, by means of a mirror, at a small angle upon the surface of perfectly clean water contained in a circular beaker. A double convex lens of long focus was now placed in the path of the reflected beam, and an image of the surface of the water formed upon the ceiling—a distance of about 15 feet. On placing a drop of oil of lavender on the surface of the water, the exquisite play of colours which precedes the formation of the peculiar cohesion figure of this oil appeared with unexpected brilliancy on the screen, and the gradual development of the somewhat characteristic pattern which the oil affords could be easily watched from a very considerable distance. The experiments can obviously be extended to any required length, and I merely mention the matter here since Professor Tomlinson, in the account of his researches which I had the

pleasure of listening to at the Manchester Meeting of the British Association, contented himself by exhibiting the mode of experimenting he employed and fine drawings of the cohesion figures afforded by different substances.

Before closing this hasty letter you will, perhaps, allow me to offer one or two other suggestive remarks.

Since the valuable "Dictionary of Chemistry" of Mr. Watts has now been successfully completed, I think most chemists will agree with me that it would be a matter of considerable regret that any of the advantage gained by the publication of so important a work should be lost by the necessarily growing incompleteness of its contents. I would, therefore, suggest the publication of an annual volume of the dictionary, thus in one sense following the example of our German brethren, but in reality, following the original plan of the work, and enabling British chemists possessing a copy of the dictionary to accurately appreciate the extent and character of the annual progress made in chemistry. That this would be a boon there can be no doubt, since few chemists can spare the time necessary to keep themselves thoroughly *au courant* with the progress of our science in more than two or three of its many branches. I would also draw the attention of chemists to the advantages which may be derived from the employment of Professor Everett's "Universal Proportion Table," in the routine calculations required in analytical work. The table is essentially a greatly extended slide rule. When its use is once understood all the troublesome sums in proportion, &c., so constantly necessary, can be performed by simple adjustment and inspection with considerable accuracy. The table is published by Longmans, and costs but a few shillings. I have had it in use in my laboratory for some time past with considerable advantage.—I am, &c.,

J. EMERSON REYNOLDS.

Laboratory, Royal Dublin Society,
Kildare Street.
November 24th, 1868.

Peridote Meteors.

To the Editor of the CHEMICAL NEWS.

SIR,—After reading M. Meunier's remarks on my letter in No. 467 of the CHEMICAL NEWS (*Amer. Repr.*, Jan. 1869, page 45,) I looked over the whole of the analyses we possess of meteoric stones, and I find that, with the exception of the remarkable stone of Chassigny, to which I called your attention, no aërolite has ever shown so much as 75 per cent of peridote, as found in M. Pisani's analysis of the stone which fell this year at Ornans; M. Pisani was, therefore, fully justified in calling attention to this fact, and my letter merely furnished one more instance—viz., a meteoric stone containing even more than 75 per cent of peridote.

Now, with regard to the presence of metallic iron in the Chassigny meteorite, M. Damour (one of the most expert analysts in Paris) does not find any (*Comptes Rendus*, 1862), and if any other chemists think they have done so, it would be interesting to know how they detected it. But whether there be in this stone a minute amount of metallic iron or not, it does not interfere with the statement in my first letter—viz., that the Chassigny meteorite contains even more than 75 per cent of peridote, which large amount was found by Pisani in the Ornans meteorite (July, 1868), to which I now add that no other meteoric stone hitherto (November, 1868) analysed has shown so much peridote as these two; they must, therefore, in spite of M. Meunier's contrary assertion, be regarded as very remarkable in this respect.

The fact alluded to also in my first letter, that meteorites which are very rich in peridote appear to have fallen without the usual striking phenomena of light, but merely accompanied with detonations, &c., will tend to confirm the opinion that this evolution of light is owing to the rapid combustion of the metallic ingredients of aërolites during their passage through our atmosphere. Hence it is hoped, as I have elsewhere shown, that the limits to which our

atmosphere extends (if it has a limit) may be known some day by noting the height of shooting stars—I am, &c.

T. L. PHIPSON, Ph.D., F.R.S.

The Cedars, Putney, S.W.,
Nov. 22, 1868.

MISCELLANEOUS.

The Water Supply of Towns.—Newspaper readers cannot have failed to notice the monthly returns in which the Registrar-General superadds to the tables of death and disease some irrelevant returns of the analysis of water. Only a few leisurely and sceptical students take the trouble to ascertain that the connection between mortality and apparent impurity of water is entirely hypothetical. The Registrar or his subordinates understand the law of mental association, if not the physical properties of water, and as the discussion at Birmingham proved, they have, like their favourite element, by constant dropping, worn into the popular mind the belief that impure water is the origin of all diseases. If it were possible to publish statistical tables of food, of cookery, of air, of exercise, of overwork, of anxiety, and of all other conditions of health and disease, it would be proper to include in the list the analysis of water. The juxtaposition of one among many causes with a complex effect can only suggest a fallacious result, yet the error or superstition is almost innocuous because it tends in a safe direction.—*Saturday Review*.

Danger Arising from the Exhalations of some kind of Fruit.—It is a well known fact that the perfume of some kinds of flowers is injurious to health, and even cause death, if flowers are kept in a confined space frequented by men at the same time. One of the local papers of the city of Lyons now records the fact of death by asphyxia, suffered by a lady who slept in a room wherein a large quantity of quinces were kept; according to scientific evidence, given in this instance, the air of the room was largely vitiated with a peculiarly suffocating perfume, and a very considerable amount of both carbonic acid and carbonic oxide gas. The room in question was always used as a bed room; no fire had been lighted in it, nor was any other discernible cause for the death of this lady found but the exhalations of the fruit.

The Science Lectureship at the City of London School.—At a recent meeting of the school committee, the post lately vacant by the resignation (through ill-health) of Mr. Thomas Hall, B.A., has been conferred upon Mr. Henry Durham, who for seven years past has assisted Mr. Hall in the duties of his appointment, and taken under his charge the junior division of the school.

Dr. Herapath, M.D., F.R.S., &c.—This eminent physician, chemist, microscopist, and botanist, who has been suffering from jaundice for some time, died at his residence in Bristol, on Monday, the 12th inst. The deceased was the eldest son of the late Mr. William Herapath the well-known analyst. The doctor was a fellow of most of the leading learned societies, besides being the author of several papers of interest; one lately published, "On the Use of the Spectroscope and Microspectroscope in the Discovery of Bloodstains and Dissolved Blood," was greatly thought of by the profession.

The Fungus Theory of Disease.—In a short communication to the *Centralblatt*, Drs. Bergmann and Schmiedeburg describe a crystalline substance, to which they have applied the name "sulphate of sepsin," obtained from putrefying materials, and which they believe represents the proper poison of organic substances undergoing this kind of fermentation. It is obtained, says the *Lancet*, by diffusion through parchment paper, precipitation with corrosive sublimate from an alkaline solution, removal of the mercury by silver, of silver by sulphuretted hydrogen, evaporation, and purification of the residue. Large, well-defined, acicular needles are thus obtained, which are deliquescent in the air, and exposed to heat, melt and carbonise. They possess a powerfully poison-

ous action. A solution containing scarcely more than one-hundredth of a gramme was injected into the veins of two dogs. Vomiting was immediately induced, and after a short time diarrhoea, which in the course of an hour became bloody. After nine hours the animals were killed, and on examination their stomachs and large intestines were found ecchymosed and the small intestine congested. Frogs could be killed in the same manner.

Baron Liebig's Advice in Respect to Bread Making.—It is a well known fact that the products of the ordinary fermentation of bread are carbonic acid, a portion of which is retained in the dough, and by its expansion on the sponge being submitted to the heat of the oven, renders the bread spongy; besides this, butyric acid and also alcohol are generated at the expense of a portion of the starch contained in the flour, a loss amounting to about from 2 to 4 per cent of the flour applied for bread making. The alcohol is irretrievably lost, and its loss is estimated by Liebig to amount for Germany to 50,000,000 of litres annually, and for London (the Metropolis), at 600,000 litres; all experiments tried to collect and condense this alcohol have turned out failures. Liebig recommends the following ingredients:—50 kilogrammes of rye meal, 500 grammes of bicarbonate of soda, 2,125 kilogrammes of pure hydrochloric acid, 2 kilogrammes of common salt, and 40 litres of water; the bicarbonate of soda and the acid yield carbonic acid gas, which renders the bread light and spongy. According to Liebig the following are the advantages of the use of this method above the old-fashioned fermentation process, 1st,—saving of time and material, since, no alcohol or other by-products are formed. 2nd,—this bread does not readily become mouldy, since, not having been mixed with yeast, it does not contain, as is otherwise always the case, the spores of cryptogamic plants which are the cause of mouldiness. The objection to the use of this bread by many people is its insipidity and want of a flavour the palate has from childhood become accustomed to. To mend this defect Liebig recommends the addition of from 4 to 8 litres of good vinegar upon 100 kilogrammes of flour, and to correspondingly decrease the quantity of water. When it is desired to give to this kind of bread the taste of soldier's bread, *pain de munition*, one should add to the dough and mix up with it 250 grammes of rather dry, not too rich, cheese. Liebig observes that at Munich bread is now largely made according to the plan described; it only takes four hours to convert a hundredweight of flour into bread. As will be readily observed by the majority of readers, Liebig's process is on the small scale. Dr. Daughlish's system, the celebrated German *savant* observes, has neither in Paris nor other French towns, taken at all well. The same applies to Belgium and Holland. Instead of rye meal, wheaten flour can be taken.

Water Supply and the Death Rate.—The inquiry which was made two or three years ago in consequence of an outbreak in the East of London, proved, to the surprise of some of the men of science who took part in the investigation, that, after excluding the case of tainted wells, there was no assignable relation between the purity of water and the health of the consumers. The quality of water supplied to the West of London from the Thames, and to the Eastern half of the metropolis from the Lea and the New River, is, on an average, uniform. As the sources of supply in all cases are the chalk districts to the North and to the West, the water contains a considerable admixture of lime, and the total amount of solid matter is considerable. The analytic chemist, offended with the presence of alien substances, delights to contrast the water which the New River Company distributes in the City of London with the limpid produce of the Scotch granite or the millstone grit of Lancashire and Derbyshire. The typical water supply was proved some years since for Glasgow by Mr. Bateman; and the same skilful engineer has furnished Manchester, at an expense of more than a million sterling, with an almost equally pure supply stored from the rainfall on the ridge which feeds the Irwell and the Mersey. The natural reservoir of Loch Katrine discharges itself into the mains of Glasgow with a merely nominal admixture of

solid matter in a gallon; and sanitary enthusiasts at Birmingham and elsewhere are in the habit of expatiating on the advantages which London would derive if an equally pure supply were provided from the Northern Lakes, or from the upper waters of the Dee or the Wye. It unluckily happens that the death rate in London is comparatively low, and that in Glasgow and Manchester it is extraordinarily high. When the objection is raised, the water fanatics reply, with good reason, that there are many other causes besides the quality of water which affect health and life; but they forget that they have themselves undertaken to prove the connection between solid matter in water and disease. Sanitary pursuits produce a kind of intoxication which raises the intellect of a genuine theorist above the vulgar rules of induction. If an epidemic breaks out in London, the evil is at once attributed to the water, while it is assumed that Manchester and Glasgow would be even more unhealthy than at present but for the purity of their supply.—*Saturday Review*.

Liebig's Extract of Meat.—A paragraph having appeared in *Once a Week*, containing imputations upon Liebig's extract of meat as an article of food, the following explanatory letter, addressed to the editor of *Once a Week*, has been forwarded to us for insertion:—

"Sir,—Your last number, dated 31st October, refers to assertions of a Dr. Kemmerich that Liebig's extract of meat acts, in large doses, as a poison. You are probably not aware that extract of meat is, in fact, nothing but solid beef tea, from which the water has been evaporated, free of fat and gelatine; and that the extract has been used both for medical and household purposes for years past, with such increasing success that the main difficulty of dealers generally has been to find an adequate supply for the rapidly augmenting demand. The medical profession, eminent scientific authorities, and Government Commissions have reported very favourably on extract of meat as an article of food, and there has never been a single instance of its use having produced any injurious effect. It is manifest that the insinuation that the extract is poisonous in any way is perfectly absurd.—I am, Sir, your obedient servant, CHAS. ROTTER, Secretary."

Failure of Photographing the Eclipse in India. It is a matter for deep regret and mortification that the photographic part of the operations of the expedition sent out from England to India to observe the late solar eclipse was a comparative failure. Some weeks ago the members of the Royal Astronomical Society received copies of a letter sent by Major Tennant to the Astronomer-Royal, recording the results obtained at Guntoor on the 18th of August. The photographic portion of the report was so unsatisfactory, or even humiliating, that we felt little inclination to publish it. An extract secured from a second letter, although recording that the results were better than were at first believed, does not serve to redeem the operations from the stigma of comparative failure. Our first impulse, on reading such a statement as the result of such an expedition on such an occasion, was to repeat the famous sentence of Ruskin, "This is not failure, but disaster!" Compared with the results obtained by Mr. Warren de la Rue in Spain, in 1860; compared with those secured by the German expedition, and recorded in our pages by Dr. Vogel, such an issue as the above is most humiliating. The plates were underexposed, and covered with spots, we are told, as though the possibility of guarding against such contingencies was a thing undreamt of. In a subsequent letter to Mr. Warren de la Rue, Major Tennant is more hopeful, and better satisfied with the results obtained. The result of the underexposure, it is here suggested, was less injurious than was at first suspected; but the multitude of spots, from the nitrate of silver becoming "concentrated," of course nothing can remove, and their presence must seriously interfere with the value of the photographic record of the eclipse. This expedition was sent out by the Royal Society, aided by Government, and we fear very much that it is to

the aid of the latter much of the failure may be attributed. It is probable, in fact, that it is due to red tape. A staff of men provided by Government might or might not be fitted in all respects for the work; but if the men "told off" for the duty knew nothing of photography, it would be against all precedent to import a photographer from another department. If the men were selected from the Engineers, and they were not familiar with photographic operations, it would be quite inadmissible to introduce amongst them men from (say) the Artillery, who were skilled photographers. It is probable, from what we can learn, that to a cause of this kind the failure in result was due. Be this as it may, however, it appears tolerably clear that no experienced photographer formed part of the expedition staff, or we should not have heard of such puerile difficulties as spots from concentrations of the silver solution. The photographic operations of the German expedition were admirable in their systematic provision. Possible forms of failure were anticipated and carefully provided against. The condition of the various chemicals was carefully tested, and the relative working conditions of various collodions ascertained under the precise circumstances in which they would be required. Preliminary exposures were tried on the spot. In short, everything was so well rehearsed, and every one so carefully told off to his duty, that failure from preventable causes was scarcely possible. If this expedition were distinguished by anything of military routine, it was in the efficient drill by which they prepared themselves for actual operations; whilst the one military element which was missing in the expedition in India was this effective drill. We have in this country several photographers of high repute and great practical skill who have had experience in Eastern photography, and who have succeeded amid the gravest difficulties. We refer to such men as Bedford, and Frith, and Goode. Surely it would have been possible to have secured the services of some of these or other experienced photographers to whom the purely photographic operations should have been confided, and who would have certainly secured immunity from the disasters attending concentrated silver solutions, and probably also from the risk of under-exposure.—*The Photographic News*.

Condy's Fluid.—The judges of the Havre Exhibition have awarded three prizes to Mr. H. Bollmann Condy for his Patent Fluids, viz., the silver medal in Class II., the silver medal, and special vote of approbation at the Naval Medical Congress.

Royal Institution of Great Britain.—Christmas Lectures.—A course of six lectures (adapted to a juvenile auditory) "On the Chemical Changes of Carbon," will be delivered by William Odling, Esq., M.B., F.R.S., Fullerian Professor of Chemistry in the Royal Institution, on the following days, at three o'clock:—Lecture I., Tuesday, Dec. 29th, 1868; II., Thursday, Dec. 31st, 1868; III., Saturday, Jan. 2nd, 1869; IV., Tuesday, Jan. 5th, 1869; V., Thursday, Jan. 7th, 1869; VI., Saturday Jan. 9th, 1869; *Subjects of the Course*:—Change from marble or limestone to carbonic gas, and from carbonic gas to charcoal. Reverse change from charcoal to carbonic gas, and from carbonic gas to limestone. Nature of the change from charcoal to carbonic gas. Carbonic gas, and consequently charcoal, a constituent of the air. Artificial changes of coal, wood, peat, and bone, into charcoal. Curious changes of other substances brought about by charcoal. Use of charcoal to effect the purification of air and water. Changes of charcoal from one form to another. Changes of charcoal into various substances. Strange properties of the substances formed by union of charcoal with oxygen, with sulphur, and with hydrogen. Charcoal the chief constituent of wood and vegetable tissue. Burning of charcoal and wood as fuel, to furnish heat. Change of burnt wood and charcoal into carbonic gas. Unburning of carbonic gas into wood and charcoal. Heat, furnished by the burning of wood and charcoal, traceable to the sun.

Lamentable Accident.—On Wednesday, October 28th, a most deplorable accident occurred in an extensive chemical works at Runcorn, Cheshire. A young gentleman, William Henry Exall, B.Sc., B.A. (London), who occupied the situation of analytical chemist there, was going through the works between 6 and 7 p.m., and, in the obscurity of the evening, actually walked into a vat, sunk about 3 feet in the ground, and containing a hot acid solution of chloride of copper. He sank up to the neck, but managing by some means to get out himself, he walked to another part of the works, where he obtained assistance, was borne to his lodgings on a stretcher, and after thirty-six hours of great suffering, breathed his last at 6 a.m. on Friday morning, October 30th, aged twenty-two years. He was a young man with acquisition and talent of the highest order, and combined with an unaffected simplicity of manner and noble-hearted generosity of sentiment which were alone sufficient to win him the admiration and affection of all who knew him. He was a true Christian. A few weeks before his death he had commenced reading for the degree of Doctor of Science. The writer, whose successor he was at the above-mentioned works, mourns in his loss that of a dear and much-valued friend.—WATSON SMITH, F.C.S.

The New High School and Laboratories of Paris.—The provisions of the recent decrees for the establishment of a practical high school and laboratories of study and research, already noticed in the *Journal of the Society of Arts*, are being carried into effect on a grand scale, and the demands for admission exceed all expectation. As regards the school, there are already more than 150 applications, viz.:—Fifteen for the section of mathematics; fifty-one for that of physics and chemistry; forty-seven for natural history and physiology; and forty-four for the section of history and philology. Amongst the candidates inscribed are several young men who have taken the degree of *agrégé*, or doctor, and others who quit the career already entered upon for the new school; many of the applicants are foreigners. The studies will commence in all the four sections at the usual scholastic period—viz., the middle of November. Some of the laboratories will be opened about the same time. At the Sorbonne, the laboratories of physics, botany, physiology, and geology, to which MM. Desains, Duchartre, Claude Bernard, and Hébert have been appointed, will shortly be ready, and a large chemical laboratory, over which MM. Pasteur and Sainte Claire Deville will preside, is now being erected by the side of the physical laboratory built last year and directed by M. Jamin. At the College of France and at the Ecole Normale, the chemical laboratories of MM. Balard and Berthelot will be ready in good time; and those of M. Claude Bernard for physiology, and M. Pasteur for physiological chemistry, somewhat later. At the museum of the Jardin des Plantes, the laboratories of Milne Edwards for zoology, and of M. Decaisne for vegetable culture and physiology, are ready. New and larger establishments are being arranged for botany, chemistry, and comparative physiology. The provinces express the desire that their laboratories should be considered as annexes of the new school; several towns propose to develop their means of superior education; and the Conseil-Général of Calvados has taken the lead by voting a grant of money in aid of the study of agricultural chemistry in the laboratory of research, instituted at the Faculty of Sciences of Caen. The council of the new high school is convened for the third of November, and the following are the names of the members appointed, in addition to those mentioned in a former notice, who have seats in the council on account of their official positions:—In the section of mathematics, MM. Bertrand, Chasles, Delaunay, and Serret, members of the Institute of France; M. Puiseux, professor in the Faculty of Sciences of Paris. Section of physics and chemistry, MM. Balard, Frémy and Wurtz, members of the Institute; MM. Desain and Jamin, professors in the Faculty of Sciences. Natural sciences: MM. Claude Bernard, Brongniart, Decaisne, and Milne Edwards, members of the Institute; M. Hébert, professor in the Faculty of Sciences.

Historic and philological sciences: MM. Maury, L. Rénier, de Rougé, and Waddington, members of the Institute; M. Bréal, professor in the College of France. The list of the laboratories given above shows the extent to which this new system of superior scientific education is to be carried, and the names of the professors and members of the governing council afford a guarantee of the quality of the instruction to be afforded. The scheme is certainly the most important and the most extensive of all those which have yet been put forward for the dissemination of high scientific knowledge.

Cohesion Figures.—We have received from Dr. R. Carter Moffat some specimens of cohesion figures of rape oil on water, fixed on paper in colours by a new process. Our correspondent is now working out the subject, and promises further particulars shortly.

British Sea-weed Charcoal.—This preparation, which has been patented by the British Sea-weed Company, is found to be a good substitute for animal charcoal, as a filtering medium for water, deodorising sewage, clearing white glass, removing acidity from and decolourising wines and spirits, and precipitating and decolourising vegetable alkaloids. It is manufactured from the fine tangle of the *Hebides*.

The Quarterly Journal of Microscopical Science.—We are requested by the publishers of the above journal to state that that journal will continue to be published as usual by the Messrs. Churchill, and edited by Dr. Lankester and Mr. E. Ray Lankester. The only change consequent upon Dr. Lankester and Professor Busk ceasing to edit the "Transactions of the Royal Microscopical Society," will be that the Transactions of that Society will not be published separately in the pages of the journal.

Advertisements and Certificates.—Some correspondence in a morning contemporary reminds us that the public seldom take the trouble to distinguish between advertisements when the notices include a chemical certificate. A tradesman anxious to inform the world that he has for sale some particular article of general consumption proceeds to advertise the same. So far good. If a shopkeeper can supply bread, beer, wine, sauce, pickles, pills, cocoa, cod-liver oil, or other article of food or medicine, better and cheaper than housekeepers have hitherto been able to obtain it, let him by all means say so in any ordinary way he pleases. Further, if a manufacturer desire to strengthen his own statements as to the merits of his goods, there can be no objection to his employment of an analyst and the publication of the chemist's report in newspapers, circulars, and labels. Nor is the public to blame for accepting the statements of well-known Professors of Chemistry, nor the latter for giving such statements, concerning the purity or quality of those liquid and solid substances which cannot, like a bottle of blacking or a joint of meat, be appraised by effects or appearances. But buyers are wrong in forgetting that the certificate of a chemist only applies to the particular sample analysed; vendors are wrong in wrapping the certificate round every package they sell, and those chemists are wrong who word certificates in such a general way as to admit of readers being misled. An analyst's report should pointedly refer to the single specimen examined, and, when used in an advertisement, should be accompanied by a declaration on the part of the manufacturer that every parcel sold is of equal quality to that analysed. It is, perhaps, only right to say that leading chemists demand these, or similar conditions, before consenting to allow their names to be cited for trade purposes, and many, in view of the abuse on which we are commenting, refuse such certificates altogether. Without some such precaution the publication of chemical certificates relating to articles of food, drink, or medicine, or the statement that certain goods are "highly spoken of by the medical press," or "recommended by the faculty," whatever that may mean, avail nothing.—*Express*.

University of London.—The following gentlemen have passed the second B.Sc. examination:—Second Division. Bennett, Alfred William, M.A., Univ. Coll.; Hopkinson, John, Trin. Coll., Camb., and Owen's, Manchester; Maxwell, Theodore, Univ. Lond. and King's, Cambr.; Ricks, George, King's, Coll.; Robinson, Arthur, Owen's Coll.; Sheldon, Charles, B.A., Owen's Coll.; Tilden, William Augustus, private study; and Wormell, Richard, M.A., University College. *Honours in Chemistry.*—First Class. Tilden, William Augustus (disqualified by age from receiving the University Scholarship).

Photographic Appointment.—We have much pleasure in announcing that Mr. J. Spiller was elected Honorary Secretary of the Photographic Society, in succession to Dr. H. W. Diamond, at the meeting of council on the 17th inst. Furthermore, that he has been induced to tender his resignation of the post of Assistant Chemist in the War Department in order to accept an appointment in the Atlas Chemical Works, Hackney Wick, of which his brother, Mr. William Spiller, is part proprietor.

Reprints and New Editions.—Our attention has been drawn by Professor Pepper to a subject of some importance to scientific authors. A recent number of one of our contemporaries gives a somewhat severe review of the "Boys' Playbook of Science," the title of which designates it a "New Edition, 1869." We are informed by the author that this is simply a reprint of the old edition published ten years ago, with a new title-page, and has been issued without his revision or co-operation. This is a matter of great importance to scientific authors, as very few in the present state of science would care about their works written ten years ago being put forward and criticised as if they had been brought down to the present state of science. The result in the present case has been that Professor Pepper's work is reviewed in much more severe terms than would probably have been adopted had the writer known that he was reviewing an old book.

The Royal Society.—At the annual meeting of the Fellows of this Society on Monday last (St. Andrew's day), the gold medals of the Society were awarded as follows:—The Copley to Sir Charles Wheatstone, D. C. L., Oxon., Professor of Experimental Philosophy, King's College, London; the Romford medal to Dr. Balfour Stewart, M. A., Superintendent of the Kew Observatory of the British Association. Of the two Royal medals, one was awarded to the Rev. Dr. Salmon, Regius Professor of Divinity in the University, Dublin; and the other to Mr. Alfred Russell Wallace, well known by his researches in the zoology of the Eastern Archipelago. At the same meeting, the following officers and council were elected for the ensuing year:—*President*, Lieut.-General Edward Sabine, R.A., D.C.L., LL.D. *Treasurer*, William Allen Miller, M.D., LL.D. *Secretaries*, William Sharpey, M.D., LL.C., George Gabriel Stokes, Esq., M.A., D.C.L., LL.D. *Foreign Secretary*, Professor William Hallowes Miller, M.A., LL.D. *Other Members of the Council*, Frederick Augustus Abel, Esq., Sir Benjamin Collins Brodie, Bart., M.A., William Benjamin Carpenter, M.D., J. Lockhart Clarke, Esq., Frederick Currey, Esq., M.A., Warren De la Rue, Esq., Ph.D., Sir William Fergusson, Bart., William Henry Flower, Esq., Captain Douglas Galton, C.B., John Peter Gassiot, Esq., John Hawkshaw, Esq., John Marshall, Esq., Joseph Prestwich, Esq., George Henry Richards, Capt. R.N., Archibald Smith, Esq., M.A., Lieut.-Colonel Alexander Strang.

Royal Institution of Great Britain.—*Friday Evening Arrangements.*—Jan. 15th Professor Tyndal, F.R.S., M.R.I., "On Chemical Rays and Molecules." Jan. 22nd Professor Alexander Herschel, "On the last Eclipse of the Sun." Jan. 29th John Ruskin, Esq., "On the Flamboyant Architecture of the Valley of the Somme." Feb. 5th James Fergusson, Esq., F. R. S., "Tree and Serpent Worship, as exemplified by recently-discovered Indian Monuments." Feb. 12th Colonel W. F. Drummond Jervois,

"On the Coast Defences of England." Feb. 19th C. Greenville Williams, Esq., F.R.S., "On the Female Poisoners of the Sixteenth and Seventeenth Centuries." Feb. 26th John H. Bridges, M.A., B.M., late Fellow of Oriel College, Oxford, "On the Influence of Civilisation upon Public Health." March 5th. Williams Huggins, Esq., F.R.S., "On the Latest Discoveries in Astronomy made with the Spectrum." March 12th. Professor Abel, F.R.S., "On some Applications of Electricity to Naval and Military Purposes." March 19th. Dr. Crum Brown, "On Chemical Constitution and its Relation to Physical and Physiological Properties."

PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2950. R. Oxland, Plymouth, Devonshire, and J. Hoeking, jun., Redruth, Cornwall, "Improvements in calcining ores and minerals."—Petition recorded September 25, 1868.
3112. T. Mers, Hebburn, Durham, and G. Thomson, Pelaw-Main, Durham, "Improvements in calcining ores, minerals, and other substances, and in furnaces therefor."—October 10, 1868.
3167. R. Pearce, Swansea, "Improvements in the separation of copper and other metals from silver and gold, the same being applicable to other metallurgical operations."
3171. W. E. Newton, Chancery Lane, "Improvements in the manufacture of syrup and sugar."—A communication from N. Pigeon, Brooklyn, New York, U.S.A.—October 16, 1868.
3203. G. Chapman, Glasgow, N.B., "Improvements in treating sewage in order to obtain valuable products therefrom."—October 20, 1868.
3036. R. Hellmann, and F. Hart, Manchester, "An improved method of utilising the fumes or vapours evolved during certain chemical operations."—Petition recorded October 5, 1868.
3086. J. Dewar, M.D., Kirkcaldy, Fifeshire, N.B., "Improvements in preparing food from the entrails of animals."—October 8, 1868.
3101. H. A. Archereau, Boulevard St. Martin, Paris, "A new method of obtaining heat and light and its various applications, and in apparatus connected therewith."—October 9, 1868.
3138. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and means for, dyeing hair."—A communication from W. Patton, Springfield, Mass., U.S.A.—October 13, 1868.
3149. W. Lorberg, Brunswick Place, City Road, Middlesex, "An improved process of treating cotton seed, and utilising the refuse resulting therefrom."—October 14, 1868.
3177. E. T. Hughes, Chancery Lane, "An improved adhesive substance."—A communication from J. and A. Tolin, Montreuil, France.—October 17, 1868.
2958. A. Kollason, Pembroke Road, Clifton, Bristol, "Improvements in purifying coal-gas and obtaining ammonia from coal-gas products."—Petition recorded August 20, 1868.
3118. F. W. Hart, Kingsland Green, Middlesex, "A new (or improved) material or substance to be used for varnishing or protecting the surfaces of lithographs, photo-lithographs, and other like printed surfaces."—October 19, 1868.
3194. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved method of preparing, desiccating, and preserving fish."—A communication from W. D. Cutler, Philadelphia, Penn., U.S.A.—October 19, 1868.
3206. J. Sykes and G. Mallin, High Holborn, Middlesex, "An improved composition to be used for 'filling up' the bodies of carriages and other substances previous to receiving the colouring matter."—October 20, 1868.
3250. J. Spratt, High Holborn, Middlesex, "Improved preparations of food for horses, cattle, game, poultry, and other domestic animals, such preparations being capable of admixture with compounds for the production of a medicated food for man."
3256. A. Girard, Gray's Inn Road, Middlesex, "Improvements in separating silver from argentiferous lead, in purifying lead, and in apparatus for the same."—October 24, 1868.
3267. F. M. Crane, Manchester, "An improved compound or size to be used in sizing and dressing cotton yarns or cotton warps."—October 26, 1868.
3285. J. Little, Glasgow, N.B., "Improvements in glass furnaces."—October 27, 1868.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

3237. A. B. Bérard, Avenue Montaigne, Paris, "Improvements in the processes and apparatuses for converting cast-iron into steel."—Petition recorded October 23, 1868.

NOTICES TO PROCEED.

2042. E. Mucklow, Bury, "Utilising refuse tanning matters for dyeing purposes."—Petition recorded June 25, 1868.
2067. J. Bagge, High Holborn, Middlesex, and F. Brazy, Camberwell, Surrey, "Improvements in the extrication and condensation of ammonia, and in the manufacture of ammoniacal salts."—June 27, 1868.

257. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of phosphates of lime, and in obtaining products therefrom."—A communication from E. Pérouze and L. Dusart, Paris. July 7, 1868.
258. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of a red colouring matter."—A communication from Chavel, Basle, Switzerland.—July 22, 1868.
259. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in converting cast-iron into wrought-iron, and in uniting castles and fluxes with molten cast-iron."—A communication from T. Blair, Pittsburg, Penn., U.S.A.—September 28, 1868.
260. B. E. R. Newlands, Charlton, Kent, "Improvements in the manufacture of manure, and in the production of salts of ammonia."—October 3, 1868.
261. J. Mitchell, Bradford, Yorkshire, "Improvements in furnaces."—Petition recorded June 24, 1868.
262. L. Thomas, Leadenhall Street, London, "A new or improved apparatus to be used along shore for the distillation of pure water from salt water, or impregnated with earthy or other matters."—June 25, 1868.
263. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and apparatus for, dyeing textile fabrics and yarns."—A communication from L. Gonchon, Lisleux, France.—June 27, 1868.
264. T. Metz, Hebburn, and G. Thomson, Pelaw-Main, Durham, "Improvements in calcining ores, minerals, and other substances, and in furnaces therefor."—October 10, 1868.
265. A. Fryer, Manchester, "Improvements in the concentration and treatment of saccharine and saline solutions, and in apparatus employed therein."—Petition recorded July 4, 1868.
266. A. Fryer, Manchester, "Improvements in the mode of treating, for evaporating and concentrating purposes, cane juice, beet-root juice, and other saccharine and other solutions and liquids, and in the construction of apparatus for the concentration of saccharine and other solutions, and for the evaporation of liquids."—July 6, 1868.
267. K. Coppée, Haine St. Pierre, Belgium, "Improvements in the construction of coke furnaces."—July 7, 1868.
268. E. Herring, Beer Lane, London, "Improvements in the treatment of saccharine solutions of malt or sugar."—July 29, 1868.

NOTES AND QUERIES.

Rock Phosphates.—Can any of your readers inform me if these can be had, and the price in quantity?—L.

Acetic Acid.—Which is the best way to estimate acetic acid in commercial acetate of lime, which contains a large quantity of tarry compounds of lime?—G. N.

Reichenbach's Researches in Magnetism.—Will you kindly allow me to ask through the medium of your Notes and Queries where I can obtain a copy of "Reichenbach's Researches in Magnetism, Part 3rd," translated by Dr. Gregory? I have with much difficulty procured Parts 1st and 2nd, and am told that Part 3rd must be out of print.—A. SCHREIBER.

Coat Tur Products.—On mounting crystals of picric acid (purified until white) for the microscope, I find that the crystals form in clusters of needles branching from a common centre, forming minute trees and shrubbery, both singly and in clusters; these crystals are so minute that their structure is not distinguishable by the unassisted eye. Pure carbolic acid in crystals if warmed, and when melted poured into a bottle and shaken up so as to smear the sides, will form the same style of crystal, only that with the carbolic acid the crystals are from a half to two and a half inches long from the base to the tips of the branches. Picrate of potash, when exploded, gave a very distinct smell of bitter almonds. Is this the ordinary result of its decomposition, or is it due to impurities?—NEW BENE.

Salamander would be glad to know what is the best coating to render wood fire-proof?

Rock Phosphates.—If your correspondent would communicate with Otto Christopher, Esq., Runkel on the Lahn, near Limberg on the Lahn, Nassau, Prussia, he will meet with the opportunity of obtaining the information he desires.

Drying Oils.—I would be much obliged if any of your correspondents would assist me in this:—I desire to render unboiled linseed oil a drying oil, without heating at all. I have tried the plumbic acetate process of Liebig, and the manganic borate mentioned in Ure, but have failed. I know there is a process by which unboiled linseed oil can be made to dry quickly (within 24 hours), but I have completely forgotten regarding it. Perhaps Dr. Adrian, or some other of your well-informed contributors would kindly oblige?—WATERPROOF.

Bichromate of Ammonia.—Not the least valuable feature in the CHEMICAL NEWS is the columns devoted to Notes and Queries and Answers to Correspondents. Many valuable items have I obtained thence, and I am glad to see that this column is open to American readers, and I gladly avail myself of this privilege to enquire if any of the readers of the CHEMICAL NEWS can inform me of a cheap mode of making bichromate of ammonia. Can it be made from the bichromate of potash? If so, by what process? Any information on this point will be gratefully received by TYER, Louisville, Ky.

Determination of Acetic Acid in Commercial Acetate of Lime.—The best method of ascertaining the percentage of acetic acid in commercial acetate of lime is, according to Fresenius, the following:—Put 5 grammes of the substance in a retort, add 50 c.c. of water and 50 c.c. of phosphoric acid, sp. gr. 1.2 (free from nitric acid); distill with caution to dryness, and repeat the operation, after adding again 50 c.c. of water, twice. Unite the distilled liquids, and dilute to 250 c.c. In 50 or 100 c.c. determine the acetic acid with a standard alkaline solu-

tion. It is necessary to test the distilled liquids for hydrochloric acid and if found in considerable quantity, to determine it with a standard silver solution. For particulars, see Fresenius's *Journal for Analytical Chemistry*, vol. v., p. 315.—V. C.

Analyses of Acorns.—Perhaps the following analyses of acorns, by Dr. Voelcker, as published in the *Journal of the Royal Agricultural Society* for 1868, may suit one of your correspondents who enquires upon the subject in Notis and Queries:—

PROPORTIONS OF HUSK AND KERNEL.

Husks.....	13'90
Kernels.....	86'10
	100'00

COMPOSITION OF KERNELS.

Moisture.....	40'88
Fatty matters.....	2'64
Albuminous compounds (containing nitrogen 0'703).....	4'39
Starch, Gum, and Sugar.....	46'74
Woody fibre (cellulose).....	3'74
Mineral matter.....	1'41
	100'00

—CHARLES HUNTER.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the CHEMICAL NEWS.

Comptes Rendus. August 17, 1868.

E. DE BEAUMONT: "Note on H. E. Roscoe's Memoir on Vanadium." J. NICKLES: "On Manganese-manganic Fluoride." A. REAED: "On the Volumetric Estimation of Zinc." T. DE PUGOLD: "On Chlorosulphuric Ether." H. SCHIFF: "On Condensed Urea." (Second Memoir.) E. PATERNO: "On Bichlorinated Aldehyde." "On the Action of Zinc-Ethyl on Bichlorinated Acetal."

August 24, 1868.

B. SAYY: "Memoir on the Density and Saltiness of Sea Water in the Atlantic, and on the currents of that Ocean." SALRY: "On the Colouration of Peroxide of Nitrogen."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (Mathematisch-Naturwissenschaftliche Classe.) Division 2.

March, 1868.

W. F. GISTL: "Contributions to the Knowledge of the Combinations of Double Metallic Cyanides with Ammonia." G. TSCHERNAK: "An Attempt to Develop the Equation expressing the Chemical Change which takes place in the Formation of Minerals."

Poggendorff's Annalen der Physik. No. 6, 1868.

A. TOPPER: "Optical Studies by the Author's New Method: On some Phenomena of the Electric Spark." G. MAGNUS: "On the Diathermancy of Styrene."

No. 7, 1868.

C. RAMMELSBERG: "On Periodic Acid and its Salts."

Annalen der Chemie und Pharmacie. September, 1868.

H. HUBNER and E. BIEDERMARK: "On the Preparation of Amidobenzoic Acid from Parachlorobenzoic Acid and Chlorosulphuric Acid." W. LUDWIG: "On some Combination and Decomposition Products of Triglycolimidic Acid." E. FITTIG and E. VON FUETENRACH: "Researches on Mesitylene." (Fourth Memoir.) "On the Oxidation Products of Mesitylene." W. WEITH: "On the Compounds of Nitroprusside." F. BEILSTEIN and A. KUHLEBERG: "On Substituted Alcohols and Aldehydes: Parantibenzyl Alcohol, Paradinitrobenzyl Alcohol, Paradichlorobenzyl Alcohol, Paradinitrobenzyl Alcohol, Parachlorobenzoic Aldehyde." E. NEUBOF: "On some Derivatives of Parachlorobenzyl Alcohol." C. FRIDEL and A. LADEBERG: "On the Preparation and the Reactions of a Silicon Oxychloride." J. VON LIEBIG: "On the Preparation of Allozan."

Bulletin de la Société Industrielle de Mulhouse.

June, 1868. Supplement.

A. SCHREURER-KESTNER and C. MEUNIER: "Analysis of the Gaseous Products of the Combustion of Coal from Saarbrück." A. KOSCHSTIEHL: "Researches on T. Couper's Method of Manufacturing Liquid Toluidine and Commercial Aniline."

July, 1868.

A. VIOLAND and Co.: "Note on the Author's Establishment for Drying and Preparing Herbs employed in Medicine at Colmar." KUHLMANN: "Report on A. Violand and Co.'s Establishment for Drying and Preparing Herbs employed in Medicine at Colmar." J. GERBER-KELLER: "Report on C. Curtois and Co.'s Manufacture of Nitrobenzine and Aniline at Mulhouse." MARNAS: "A New Aniline Dye." CHEVREUX: "A proposed Method of Extracting a Colouring Matter from the Cockchafer." A. SCHREURER-KESTNER: "Memoir on the Combustion of Coal." ROSENWITTEL: "Report on Method of Manufacturing Liquid Toluidine and Aniline."

Comptes Rendus, August 31, 1868.

PELIGOT: "On the Preparation of Uranium." B. TOLLENS: "On the Oxidation of Phenol." GAYARD: "A Method of Preventing the Explosion of Fire-damp in Coal Mines." A. BECHAMP: "On the Spontaneous Alcoholic and Acetic Fermentation of Eggs." W. EVANS: "Researches on the Use of Protoxide of Nitrogen as an Anæsthetic." DELAURIER: "Note on a new Exciting Liquid for Voltaic Batteries." REUSLOB: "On a new Volta-Paradoxa Apparatus."

September 7, 1868.

A. W. HOFMANN: "Note on Menaphthylamine." A. BECHAMP: "On the Caproic and Caprylic Fermentation of Ethylic Alcohol." "On the Formation of Caproic Alcohol during the Capric Fermentation of Common Alcohol."

September 14, 1868.

DE LAPPARENT: "Report on Pasteur's Method of Preserving Wine by means of Heat."

September 21, 1868.

DUMAS: "Remarks on Affinity." CHEVREUL: "Remarks on the same Subject." L. L'HÔTE and SAINT-EDME: "On the Production of Ozone in Oxygen and Air under the Influence of the Electric Spark from Ladd's Condenser."

September 28, 1868.

CHEVREUL: "On Chemical Affinity." J. LEMAITRE: "Are Typhus, Cholera, Yellow Fever, Dysentery, Intermittent Fevers, and Hospital Gangrene to be attributed to Infusorial Ferments?" V. DE LUYNES: "On some new Combinations of Orcine." A. SCHEURER-KETTER and C. MEUNIER: "Researches on the Combustion of Coal." (Second part.) F. PISANI: "Analysis of a Meteorite which fell at Orans, Doubs, on July 11, 1868."

Bulletin de la Société Chimique de Paris. September–October, 1868
P. SCHUTZENBERGER: "Mémoire on the Colouring Matters extracted from the Seeds of Persian Berries. Memoir on some Reactions producing Oxynchloride of Carbon, and on a new Volatile Compound of Platinum." A. ROSENSTIEHL: "On the Presence of an Alkaloid Isomeric with Toluidine in Commercial Aniline." E. BOURGOIS: "On the Part taken by Water in Electrolysis. Note on the Electrolysis of Benzoic Acid." H. BAUBIGNY: "On some Derivatives of Camphor." P. DE CLEMONT: "On a new Alcohol Isomeric with Octylic Alcohol." A. OPPENHEIM and G. VOGT: "A new Method of preparing Resorcine." BECHT: "Analysis of the Leaves of the Mulberry Tree." F. SESTINI: "On some Properties of Liquid Sulphurous Anhydride."

Dingler's Polytechnisches Journal. August, 1868.

A. CHRISTMANS: "A new Method of Assaying Silver by means of Oxygen Gas." "Note on A. Prandtl's Researches on the Preparation of Extract of Milk."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin. May, 1868.

ERHENBERG: "On the alleged Use of Red Earth as Food by the Inhabitants of Guinea." MAGNUS: "On the Diathemancy of Sylvine."

Poggendorff's Annalen der Physik. No. 8, 1868.

C. HAMMELSBERG: "On Periodic Acid and its Salts." "On the Crystalline Form and Optical Properties of Periodic Acid." G. JETESCH: "On the Laws of the Formation of Twin Crystals of Quartz."

Annales de Chimie et de Physique. August, 1868.

E. BOURGOIS: "On the Electrolysis of Malic Acid."

Annalen der Chemie und Pharmacie. Vol. 6, No. 2.

H. LANDOLT: "Researches on the Elasticity or the Vapours of Homologous Compounds." R. BUNSEN: "On the Calculation of Compound Feldspars." A. NAUMANN: "On the Dissociation of Hyponitric Acid." W. LOSSEN: "On the Action of Tin and Hydrochloric Acid on Nitric Ether." A. STRECKER: "Note on H. Schiff's Hydracetamide."

Journal für Praktische Chemie. August, 1868.

BUCHNER: "On the Composition of Blood when Poisoned by Prussic Acid." C. HEINTZEL: "New Researches on Triamidophenol."

September, 1868.

F. ROCHLEDER: "On the Composition of the Leaf of the Horse Chestnut Tree." "On Esculine and Esculetine." "On the Capsules of the Fruit of the Horse Chestnut Tree." "On Isophloridazine." M. JAFFE: "Contributions to the Knowledge of the Colouring Matters of Bile and Urine." R. L. MALY: "On some new Derivatives of Thiosinamine." M. DELAFONTAINE: "On some new and little known Molybdates, and on the principal Fluoroxymolybdates." C. MARIGNAC: "On the Reduction of Niobium and Tantalum Compounds." H. BAUMHAUER: "On the Causes of the Solidification of Supersaturated Saline Solutions." G. VON RATH: "On a new Crystalline Modification of Silicic Acid." I. JELSTROM: "Analyses of Epiphyllite, Damourite, and Pyrophyllite from Sweden." F. STOLBA: "On the Action of Sulphur on Sulphate of Iron." A. BAUER and E. KLEIN: "Note on the Action of Tetra-chloride of Tin on Amylic Alcohol." E. BRUCKER: "On the Detection of Ammonia in Animal Fluids, and on the Behaviour of the same in some of its Compounds."

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS give notice that in accordance with a suggestion of Mr. CROOKES, the Editor and Proprietor of the English publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with Mr. CROOKES render this very desirable to all persons in the United States who wish to confer with him. Address,

W. A. TOWNSEND & ADAMS,

434 Broome Street, New York.

A New Subscriber.—There is no special book on the subject.

E. A. P.—Our correspondent has read the passage in an entirely different sense from the one intended. We quite agree that the subject is one which need not be discussed in these columns.

S. Gibbons.—1. The report is very valuable and shall receive early notice. 2. The numbers enquired for are out of print. Your only chance is to get a bound volume, which may occasionally be picked up second-hand—at a large increase on the original price. 3. We will make special enquiries about the books you ordered. The other communications were received with thanks.

A Young Chemist.—The special details in preparing nitrate of lead in crystals can only be found out by experience. No book would enter into such minutiae as you require.

J. W. S.—You will be able to get what you require at Ladd and Oerling's.

V. C.—Received with thanks.

W. H. Walens.—If our correspondent would favour us with a short account of his theorem, illustrating its applicability for checking chemical and other calculations, it would be a boon which would be highly appreciated by many of our readers.

E. Coulthard.—Mulder's book on "Beer" is the best; but we do not think it has been translated into English. We do not know of one in this language.

Messrs. Willoughby and Melmer's courteous request shall be attended to.

Elephas.—We believe it is no exaggeration to say that the excreta of one individual, by the time the sewage is applied to the land in the way Mr. Mechl commends, is diluted with 1.443 tons of water.

Amateur.—Heat the steel till it assumes a blue tint, and then quench in cold water.

H. Sillon.—Apply to the Secretary, Burlington House.

E. A. P.—The so-called chemical weather-glass is prepared by dissolving 24 drachms of camphor in 11 drachms of rectified spirit; then dissolve 38 grammes each of nitre and sal-ammoniac in 9 drachms of water, and mix the whole. Place the liquid in a long tube, and carefully seal up. It is only a toy, and is of no value as a weather-indicator.

Communications have been received from Dr. Röhrig; Dr. Oxland (with enclosure); Dr. Muspratt; H. Kynaston; W. S. Colman; W. Little; H. A. Almond; W. Thompson; E. Harvey (with enclosure); W. Robertson; J. Morewood (with enclosure); Dr. R. Angus Smith, F.R.S.; W. Baxter; C. A. Cameron; Mawson and Swan; Brooke, Simpson and Spiller; E. P. Potter; A. C. Hadland and Co.; J. Nadal Nye and Co.; Professor Heaton; G. Wigner; Dr. T. L. Phipson; W. Little; Sydney Gibbons, Melbourne (with enclosure); E. A. Parnell; A. Liversidge; J. Goulding; W. Ferguson (with enclosure); Dr. H. Angus Smith, F.R.S.; S. Burke; H. Williams (with enclosure); Dr. Röhrig; J. Spiller (with enclosure); Brooke, Simpson, and Spiller; Bollmann, Condy and Co.; Watson Smith, F.R.S.; J. S. Smith (with enclosure); Rev. O. Fisher (with enclosure); J. Mackie; J. Storey and Co.; J. C. Lee; G. F. Rodwell; H. Hopkins; A. C. Hadland & Co.; Dr. R. Angus Smith, F.R.S.; C. Turner; Messrs. Churchill and Sons; R. Coulthard; W. H. Walens (with enclosure); E. C. C. Stanford (with enclosure); G. W. Wigner; Dr. S. Muspratt; S. Mellor; E. Jones; A. Martinelli; J. T. Hobson; V. Cruise; J. Samuelson; T. Hobbs; A. P. Hurstone; J. Cliff; W. H. Perkin, F.R.S.; F. Sutton; W. M. Watts; F. C. Macdonnell; E. P. Potter; F. C. Calvert and Co. (with enclosure); Brooke, Simpson, and Spiller; Watson Smith (with enclosure); J. Primrose; J. Hulle; Dr. R. Carter Moffatt; S. Meunier; Professor Church; W. H. Perkin, F.R.S.; R. Tatlock; H. Walens; Dr. E. Fleischer (with enclosure); Dr. Röhrig; Dr. C. W. Bingley; W. W. Stoddart; H. Taylor (with enclosure); Dr. T. L. Phipson (with enclosure); W. Little (with enclosure); Dr. H. Dobell; J. H. Pepper; Becker and Sons; Dr. C. Chandler (with enclosure); Dr. R. C. Moffatt; Dr. R. Angus Smith, F.R.S.; Muspratt and Sons; C. F. Macdonnell; J. Primrose; J. Denby; J. Heywood; F. S. Sillitoe; and J. Maccabe.

Books Received.—"The A.B.C. Sewage Process;" being a Report of the Experiments hitherto made at Leicester, Tottenham, and Leamington, on the Purification and Utilisation of Sewage. "The Elements of Heat and Non-Metallic Chemistry," by Frederick Guthrie, B.A., Ph.D., F.R.S.E., F.C.S. London: John Van Voorst. "A Manual of Elementary Chemistry, Theoretical and Practical," by George Fownes, F.R.S. Tenth Edition. London: Churchill and Sons. "Report of the United States Patent Office for 1865." 3 vols. From the Honourable the Commissioner of Patents, Washington. "Electro-Metallurgy." Practically Treated by Alexander Watt, F.R.S.S.A. London: Virtue and Co.

AMERICAN SUPPLEMENT.

New York, January, 1869.

The Philosophy of Explosions.

A cubic inch of water by heat expands into a cubic foot of vapor or steam at the ordinary tension of the air, and the mechanical force involved is the same whether the expansion be slow or rapid. The vapor rises quietly and imperceptibly from the morning dew, but it lifts the atmosphere, and with a force as real and as great as if it had been generated in a boiler, and had assisted in an explosion whose shock had brought death and destruction. What is true in this respect of the vapor of water is true of all elastic fluids: the force of expansion is measured by the amount of expansion. Given the volume of vapor and the volume of matter from which it proceeded, and the tensions at the beginning and end of the expansion, and we have all the data required for the determination of the mechanical force; and this formula is practically applicable for the solution of all cases, whether of gentle action or of violence of expansion.

Explosion belongs to the category of expansion: it implies noise and violence. "Explosion is a sudden expansion of an elastic fluid attended with violence and a loud report"; this is Webster's admirable definition. The elastic fluid may originate from solids (gunpowder, gun-cotton, iodamides), or liquids (water, nitroglycerine, chloride of nitrogen), or gases (mixtures of hydrogen and combustible vapors with oxygen). The violent expansion of elastic fluids may ensue immediately on their generation, as in the explosion of fulminates and gunpowder, or there may be a gradual accumulation until at last the restraining chamber yields to the increasing pressure, as in the case of the bursting of steam-boilers. The elastic fluid which is concerned in explosions is often a product of immediately preceding chemical action. Indeed, ordinary combustion only lacks rapidity to produce explosion; if a stick of wood or a lump of coal could be burned in an instant, there would be violence and a loud report. Common combustibles have, indeed, by chance or artifice, been burned explosively. There are many instances on record of disastrous explosions in cotton-mills from the sudden burning of fibres of cotton which filled the air; one of the standard methods of imitating lightning at the theatres is to blow powdered rosin or flour into the flame of a candle. In these cases the conditions of rapid burning are secured, and this is all the explanation they require.

The rapidity of expansion has everything to do with the character of an explosion; it determines the gradations of violence, from that of somewhat mild pressure to the sharpness of the lightning stroke, from a puff of smoke to the crack of fulminate of silver. Let us consider, for illustration, the action of gunpowder. The strength, *i.e.* the rapidity of burning, depends somewhat on the proportion of the ingredients and their thorough mixture, but much more upon the manner of burning. Pulverize the powder and strew it in a thin layer on a cold metal surface, and it can with difficulty be made to burn at all. Make it in a heap and it burns quicker as the heap is made larger. There is also a size and form of the grains which favor rapid burning; when the grains are fine the free radiation of the heat and flame is impeded, and when the grains are large the surface for combustion is lessened. The explosion of

gunpowder in the open air is seldom disastrous unless the quantity be very large, as when powder-mills are blown up. Confine the powder as for a fuse, or in a gun, and the rapidity of burning is vastly increased. Here the heat of combustion is accumulated and intensified, the confining walls acting as a reverberatory to throw back the flame and heat into the mass. The rapidity of burning of gunpowder may be greatly increased by mixing through the mass a substance like the fulminates or loose gun-cotton, which burn much more rapidly than the powder, and thus serve to carry the flame quickly to many points in the mass; the powder is touched off all over at the same instant. This plan has been found practically useful in many cases when powder, as ordinarily used, is not strong enough. The fulminate is commonly made like a quick match in the form of a tube or ribbon, and distributed through the mass of powder which is to be fired.

The lower the temperature at which an explosive will take fire, the more rapid the burning. As the temperatures of flame are nearly the same in most cases of combustion, and the combustion proceeds only on the surface, and from particle to particle, it proceeds more rapidly when little heat is required to commence it and continue it. The old fulminating powder, composed of sulphur, pearlsh and nitre, is exploded by gradually heating the mixture till it melts. In this case the whole mass becomes evenly heated to within a few degrees of the igniting temperature, when a slight disturbance starts the action which is promptly communicated to every particle. This method of increasing the strength is applicable to all explosives. Let gunpowder be confined so that its sulphur cannot escape, and be very gradually heated to the ignition temperature, it will explode with the sharpness and pulverizing effect of fulminate of silver. This principle, however, is not suitable for practical application.

Another method of increasing the strength of explosives, on account of its novelty and importance, is considered in a special article: Explosion by Concussion.

A Revolution in the Kitchen.

Most Americans, who are now on the shady side of forty, remember that in their youthful days pearlsh and saleratus, meaning carbonates of potash, were considered indispensables in the well-ordered household. Although they were manufactured in a crude fashion, and had properties which we could scarcely tolerate in the present day, they were used universally. A large part of the produce of potash went into their preparation; the people were the wood-burners, and the ashes were scrupulously preserved for the domestic soap-boiling or for the potasheries and refineries which were in all parts of the country conveniently near. There were large districts where yeast was almost unknown, and bread was not considered good unless it was yellow and alkaline from the excess of pearlsh used in raising it. But in course of time the word pearlsh has dropped out of the domestic vocabulary, and the word saleratus, although as much as ever on lips, has acquired a new meaning. These changes took place suddenly, but yet so quietly that even at the time very few were sensible of what was happening. We are not aware that the history of this revolution has ever been printed. It is this:

In the year 1846 there came to tide-water, principally to New York, 84,000 casks of pots and pearls, and the price was 4½ cents per pound. In 1847 the price

had advanced to 9 cents, and the supply decreased to 64,000 casks. These facts suggested to Messrs. John Dwight & Co. of this city, the happy thought that bi-carbonate of soda might properly be substituted for pearlash and saleratus. A comparison of the articles convinced them that the soda salt was preferable in almost every respect; and the fact that bi-carbonate of soda possessed about twice the bread-raising efficiency of pearlash, while it could be sold at a lower price per pound, induced them to embark in its manufacture. The business was therefore commenced by John Dwight & Co., in October, 1847. But, like all reformers, they were obliged to work against prejudice and misrepresentation. People said pearlash had been tried, and well enough should be let alone, while carbonate of soda was an apothecary drug which they knew of only through the doctor's prescriptions; soda might be poison. Many who tried it used the same proportion as of pearlash, and of course the bread was spoiled; these were implacable enemies. John Dwight & Co., however, conscientiously and bravely held fast, and a lasting and substantial success crowned their laudable enterprise. Their first works were of a capacity to produce 100 to 150 tons per annum—an amount, however, which was not called for in the first year; now they can turn out 350 tons per month.

The success of the revolution inaugurated by Dwight & Co. seemed guaranteed within six months, but the completion was greatly hastened by the strategy of Babbitt & Co., in the nature of a flank movement on the popular prejudice. John Dwight & Co. had been scrupulously careful to offer their manufacture under its proper chemical name, and as a different thing from saleratus, although better. Babbitt & Co., having a more yielding disposition towards the practices of trade, purchased a large lot of English bi-carbonate of soda, and put it on the American market, tastefully put up in small packages, and with vigorous advertising under the name of saleratus of a wonderfully improved quality. Babbitt & Co. were abundantly successful and they had imitators, and all to this day sell bi-carbonate of soda under the title of saleratus and some outlandish adjective. The revolution was completed in two or three years, and carbonates of potash were banished forever out of our kitchens.

The Adulteration of Food.

THE *New York World* on the 17th December commenced a vigorous exposition of the adulterations of food and spirituous liquors. The discussion has continued daily up to the present time, and in all has occupied more than fifty columns of the paper; and the end appears yet to be a great way off. The exposition is very bold, even to impudence in the estimation of some, for it calls by name the venders of the articles it condemns, thus making light of reputations which have never before been publicly assailed. Upwards of two hundred samples of groceries and liquors, representing perhaps fifty well-known mercantile houses, have been reported on, and it is supposed that many more samples are waiting description.

The manner of proceeding to procure a basis of facts was this. Purchases were made by a trustworthy commissioner and taken to the *World* office, where they were measured or weighed, and the proper records made. Samples of the goods were then made up in parcels, distinguished only by numbers, and placed in the hands of chemists for analysis. On the printing of the chemical report the names of the vend-

ers were associated with the samples. The buying of the articles, and the examinations and reports on them, were made strictly in the ordinary and legitimate manner of business, and the moral argument was managed solely by the editors.

The exposition has made a profound impression upon the public, even in some quarters partaking of the nature of a panic. The newspapers throughout the country are assisting in the discussion. There seems to be a general awakening to the importance of the subject. Yet the facts developed thus far are by no means the most remarkable and startling of their kind; grocers, who of course understand the tricks of their trade, and chemists, know that not half the truth has been told. In teas, coffees, spices, soaps, and bread-raising chemicals, adulteration and mixing are the rule, and purity and genuineness are the exceptions.

It is the innocent, confiding, and ignorant public that suffers. The venders do not impose on each other—there is honor among thieves—and old birds are not caught by chaff. (1) But the blame is not to be equally divided among the different grades of the trade. The wholesale dealers, and the manufacturers even, have our sympathy. They almost invariably charge for their goods according to quality; misrepresentation could scarcely be successful with their customers, who take pains to know what they buy; for sharpness in bargaining, commend us to one who purchases to sell at retail. It is the nature of purchasers to exaggerate the inferiority of an article, and it is about the inferiority that the jewing is concentrated. We are informed on high authority that the percentage of profit on adulterated goods among honest wholesale dealers and manufacturers is much less than in the genuine. These honest men adulterate their goods, not for the purpose of deceiving or defrauding anybody, but because their customers direct it and demand it. We know one of them, the proprietor of a large establishment, who declares that his business would be much better if adulterations were not in fashion, but as it is, he would be obliged to close his store if he did not act like his neighbors; he must sell what his customers want, or they will leave him. On the other hand, the retailer's customer is credulous and ignorant; he does not know chicory or peas from coffee, or plaster of Paris from cream of tartar; he is the miserable public. The dishonest man has but one way of dealing with such a customer; his mercy is such as the wolf shows to the lamb.

There are two remedies for the evils of adulterations: legislation and public enlightenment. Legislation is simple enough and speedy enough, but would lack efficiency; and there are serious inherent difficulties in the legislation on such a subject. Public enlightenment, in the long run, is the surer and safer remedy. Instruct the retailer's customer in the tricks of trade, and terra alba, roasted peas, spices exhausted of essential oil, and old tea grounds, will speedily disappear from the shelves of all the grocers; the retailer will have found his match.

Explosion by Concussion.

ORDINARY combustion is superficial; a burning body is consumed from the outside inwards. The oxygen is in contact only with the outside of burning coal and wood, and it is only there that the combination is possible. As burning continues, the products of combustion must be removed, and fresh oxygen be brought to take their place, and it is evident that the rapidity for

burning mainly depends upon the promptness of these interchanges. When the combustible and supporters of combustion are intimately mixed, as in gunpowder, the burning, although greatly more rapid, is still superficial. A burning particle, or molecule, sends to its cold neighbor the heat needed to ignite it, and the successive heating up and burning proceeds to the end.

A tumblerful of nitroglycerine may be set on fire by a taper, and it burns almost as quietly as alcohol or ether. The burning is evidently only at the surface, and continues downward only as fast as the heat can be carried from particle to particle; ordinary radiation and conduction of heat have little to do in this case. Instead of firing the nitroglycerine by a taper, explode a percussion-cap under its surface, and the combustion has the character of the most terrific explosion; the glass is pulverized, and the shock may be felt for a great distance on every side; the explosion seems instantaneous. In the two cases the chemical reactions are probably the same; the practical difference is mainly of the times in which they are in progress. In the second case the reactions are the result of the concussion, and as the concussion begins in, and extends through, the mass, the reactions are not superficial, as in the first case. The rapidity of the reactions is coincident with the rapidity of the progression of the concussion. As concussion proceeds more rapidly than the combustion from particle to particle, concussion explosions are always more violent.

If explosion by concussion be commenced in a part of the mass of an explosive, the concussive force is generally communicated to the whole mass, whatever be its form. Lumps of frozen nitroglycerine, and of pyrotechnic compounds, have so been exploded by sudden blows. Very remarkable examples of the propagation of concussion have recently been discovered in experiments on gun-cotton at the English War Office chemical works; it is shown that the concussive explosion may be communicated through loose fibres of gun-cotton.

The theory of explosion by concussion is susceptible of pretty wide application. Nitroglucose and nitrobenzole may be exploded in the same way as nitroglycerine, and with similar effect. All fulminates and explosive powders containing chlorate of potash, and even gunpowder, may also be exploded by concussion, and thus have their strength greatly multiplied.

In justice to himself, the writer finds it proper to state that the theory and generalization of explosions by concussion, as above outlined, have with him been a subject of thought, conversation, and experiment, for upwards of a year, and were not at all suggested by the recent English experiments on gun-cotton. The English experiments, however, hastened a publication which was made before the N. Y. Lyceum of Natural History, Dec. 21, where the subject was pretty fully discussed.

Improvement in Anæsthetics.

NITROUS OXIDE is an admirable anæsthetic for use by dentists. It is demonstrated by hundreds of thousands of cases to be safe, and is easily prepared and administered. Almost the only objection that has been fairly raised against it is the fact that sometimes it is not effective; there are occasionally persons to whom it brings only excitement in the place of sleep, or the anæsthetic action is not sufficient. J. B. Newbrough, M.D., dentist, of this city, observing such failures of simple nitrous oxide, conceived the idea that chloroform

added to the gas would supply its deficiency. The good effect was realized by the trial, and he gradually introduced the mixture into his regular practice. For each patient he uses 20 to 50 drops of chloroform, mixed with the ordinary dose of gas. The chloroform is dropped into the neck of the gas-bag just before filling. The gas on entering evaporates and absorbs the chloroform, the mixture becoming thorough and permanent. Dr. Newbrough has used this mixture for several years on thousands of patients and always with satisfactory success. The method has also been communicated to others in the dental profession, who have adopted it in their practice.

A Scientific Tract Society.

A SOCIETY is proposed for the diffusion of useful scientific information among the people by means of short tracts of the form of the ordinary religious tracts. The tracts are to be printed by the million and distributed gratuitously. The enterprise ought to enlist the earnest co-operation of the best men of science with the benevolent men of wealth. A society of the character proposed might easily become the most important of all our educational institutions.

The Oxyhydrogen Light.

THE oxyhydrogen light, which is generally known as a brilliant chemical experiment, promises to become of considerable commercial importance. A store (Ball & Black's) on Broadway is already lighted by it, and preparations are in progress for using it in the place of gas in a theatre (Booth's), and in several churches. Some of the newspapers even anticipate that it will shortly supersede the ordinary gas illumination everywhere; they find it remarkably more healthful, manageable, safe and cheap. Upon the stimulus of such praise a company, with abundant capital, has been organized for the manufacture of oxygen gas, and the whole subject will be elucidated on a very grand scale. Chemists are hopeful, although they look at the matter in a different way from the newspapers.

The application of the oxyhydrogen light to useful purposes has already received some attention in this country. It has been extensively used for the headlights of locomotives, but after a trial of a few years it has been abandoned. It was found, however, of material service, and was much used during the late war in night military operations. It has, in this city at least, superseded the old-fashioned pyrotechnic appliances of the spectacular drama at theatres. Also under the name of calcium light, a name invented by the late Robert Grant, it is a constant adjunct of political mass meetings. During the past ten years there have been constantly from one to three establishments which made their business in the manufacture of oxygen. The price charged for oxygen we believe has been almost without variation \$2 50 per 100 cubic feet. Although Mr. Grant tested most of the known processes of manufacture, he found that, all things considered, the chlorate of potash process best answered his purpose. As oxygen is now to be manufactured on a large scale, the most economical process will be in request, and chemists and inventors will do well to assist in its identification or discovery.

OUR DEAD OF EIGHTEEN HUNDRED AND SIXTY-EIGHT.

AGE.
56. ANDERSON, Charles John, Geographer, Traveller, and Author. Near Ondonga, Southwest Africa. Jan.
61. BARNHORS, Willard, Civil Engineer, Surveyor and Author. Davenport, Iowa. January 3.

AGE.

50. BARTLETT, George, Scientific Journalist and Author. Providence, R. I. April 9.
 55. BRINSMADIE, Thomas C., M.D., Physician, President N. Y. State Medical Society. Troy, N. Y. June 22.
 90. BROUGHAM and Vaux, Henry Brougham, Lord, Statesman, Jurist, and Author. Cannes, France. May 9.
 65. CASE, Rev. Joel Titus, Presbyterian Clergyman and Physician. Victoria, Texas. June 10.
 84. CHILDS, Hon. Henry Halsey, M.D., Pres't Med. Col., Lt.-Gov. of Mass. in 1843. Boston, Mass. March 22.
 85. CRAWFORD, John, Author, Diplomat, Geographer and Ethnologist. London. May 11.
 72. DANA, Samuel Luther, Author and Physician. Lowell, Mass. March 11.
 68. DAWES, Rev. William R., F.R.S., and F.R.A.S., Astronomer. Hopedale, Haddenham, Eng. February 15.
 65. DEAN, Amos, LL.D., Jurist, Author, and Professor of Med. Jurisprudence. Albany, N. Y. January 26.
 33. FENDALL, Clarence, an Officer of the Coast Survey. Norfolk, Virginia. September 17.
 74. FOUCAULT, Leon, French Physicist and Author. Paris. February.
 74. GIBSON, Dr. J. W., Eminent Physician and Antiquarian. Baltimore, Md. December 16.
 51. GILLESPIE, William Mitchell, C.E., Professor of Civil Engineering and Author. N. Y. City. January 1.
 GILLIAMS, Jacob, M.D., Physician and Naturalist. Philadelphia. February 1.
 66. GRAVIER, Conslvier, French Meteorologist. Paris, France. February.
 77. HERAPATH, John, English Mathematician and Editor *Railway Journal*. Lewisham, Eng. February 24.
 72. HERAPATH, William, English Chemist and Toxicologist. Bristol, Eng. February 8.
 77. HOMANS, John, M.D., Physician, and President Massachusetts Medical Society. Boston. April 17.
 88. JESSE, Edward, English Naturalist and Author. Brighton. March 28.
 67. KRAFT, Henry, Ph.D., a German Chemist. Brooklyn, N. Y. August 30.
 LE SAINT, Lieutenant, French Explorer and Geographer. Abu Kuka, Abyssinia. April.
 74. MACKENZIE, William, M.D., F.R.C.S.L., Surgeon, Oculist, and Author. Glasgow. August.
 MITCHELL, S. Augustus, Geographer and Author of Geographical Text-Books. Philadelphia. Dec. 20.
 48. MORTON, Dr. W. T. G., reputed Discoverer of Etherization. New York City. July 15.
 47. NICHOLS, John A., LL.D., Professor Mathematics in College of City of N. Y. New York City. Nov. 27.
 58. PAGE, Charles G., Professor of Chemistry and Physicist. Washington, D. C. May 5.
 80. PERTHES, Boucher de Crevecoeur, Geologist and Author. Abbeville, France. August 3.
 78. PICKERING, Octavius, LL.D., A.A.S., Legal Writer and Naturalist. Boston. October 29.
 67. PLUCKER, Professor Julius, F.R.S., German Physicist, Professor, and Author. Bonn, Prussia. June.
 60. SCHONBEIN, Prof. C. F., German Chemist, Inventor of Gun-Cotton. Baden-Baden, Germany. Sept. 4.
 72. STEVENS, Edwin A., Inventor, and Steamboat and Railroad Builder. Paris, France. August 7.
 58. TUCKER, Edward, English Botanist, Discoverer of Oidium or Grape Disease. Margate, Eng. March 8.
 56. TURCK, Ludwig, M.D., German Pathologist and Author. Vienna. February 25.
 67. VANDER HOVEN, Prof. J., Dutch Naturalist and Author. Leyden, Holland. March 11.
 76. VASSAR, Matthew, Founder of Vassar College. Poughkeepsie. June 23.
 53. VIRIVILLE, Vallet de, French Archaeologist and Author. Paris. March.
 WOOD, Isaac, M.D., Physician and Medical Professor. New York City. March 25.

NEW PUBLICATIONS.

A TEXT-BOOK OF NATURAL PHILOSOPHY. An accurate Modern and Systematic Explanation of the elementary Principles of the Science. Adapted to use in High Schools and Academies. With 149 Illustrations. By Le Roy C. Cooley A.M., Prof. of Nat. Science in the N. Y. State Normal School. Pp. 815. New York: Charles Scribner & Co., 654 Broadway.

The author discourses of molecules and molecular motions, having cut adrift the ancient theory of imponderables. He has no respect for error because it is venerable, and he gives it no room in his book. He sets a good example to the compilers of school-books of science.

ELEMENTARY GEOLOGY. By Edward Hitchcock, D.D., LL.D., Late Prof. of Geology in Amherst College, and Charles H. Hitchcock, A.M., Professor of Geology in Lafayette College. Remodelled, mostly rewritten, with several new chapters, and brought up to the present state of the Science. For use in Schools, Families, and by Individuals. Pp. 416.

This book has been a favorite with us since childhood; it is the source from which we have derived most of our knowledge of geology. Its great merit has made it the most prominent text-book in geology for the past quarter of a century, and it may not yet have run half its career. The revision and rewriting has been well done, and has added greatly to the value of the book.

ON CHRONIC ALCOHOLIC INTOXICATION. With an Inquiry into the Influence of the Abuse of Alcohol as a predisposing Cause of Disease. By W. Marcet, M.D., F.R.S., Fellow of the Royal College of Physicians; Assistant Physician to the Westminster Hospital, &c., &c. First American, from the second English Edition. Pp. 178. New York: Townsend & Adams.

This book was intended especially for the medical profession, but the question, Will the Coming Man drink Wine? is now so much discussed

in literary magazines and newspapers, that it will have an interest for the people in general. Drunkenness is here treated of as a disease, and its nature and remedies are discussed in a purely scientific method.

THE STOCK-BREEDER'S MANUAL. The Chemistry of Food in relation to the Breeding and Feeding of Live Stock. By Charles A. Cameron, Ph.D., M.D. Pp. 254. London and New York: Cassell, Pether & Galpin.

This is a handy and practical treatise, which at the same time has a high scientific character. It sets forth in a clear light the most useful of the modern notions and facts. We shall prize it highly for its collection of the most recent analyses of food and animal products.

Pamphlets.

VAN NOSTRAND'S ECLECTIC ENGINEERING MAGAZINE. Selected from the Home and Foreign Engineering Serials. Conducted by Alex. L. Holley, Engineer Bessemer Steel Works, Troy, Harrisburg, &c., author of *Ordinance and Armor, Railway Practice*, &c. Vol. I, No. 1, Jan. 1869. Pp. 96. New York: D. Van Nostrand, Publisher and Importer, 192 Broadway.

Knowing the great ability and experience of Mr. Holley, we anticipated just what we now have in this magazine—the most useful engineering periodical extant, at least for American readers. There is certainly need of such a magazine, and we hope that the demand will be great enough to handsomely reward the venture.

THE SUGAR INSECT, "Acarus Sacchari," found in Raw Sugar. By Robert Nicol, Esq. Greenock, Scotland. Pp. 7. Philadelphia: De Armand & Goodrich, 104 Hudson street.

A plain statement of the curious facts.

BREVITIES.

PRESIDENT CATTELL of Lafayette College, Easton, Pa., is about to visit Europe for the purpose of examining the methods of instruction employed in the most celebrated technical schools of the Old World. The information acquired will be applied to the perfecting of the scientific department of his college.

Boston capitalists have recently erected in Charlestown large sulphuric acid works on Mounier's plan of treatment. Pyritiferous ores, containing three or four per cent of copper, are crushed and mixed with a small percentage of sulphate of soda. The mixture is roasted in a furnace like Spence's, and the fumes go to make sulphuric acid. The residue is lixiviated, yielding a solution of sulphate of copper, from which the metal is recovered by precipitation on iron. It is claimed that the copper will cover the whole cost of the acid.

At the Clifton Works on Staten Island, under the charge of Wm. N. Armstrong, preparations are in progress for roasting zinc blende in such a way that the sulphur may be utilized in the manufacture of sulphuric acid. The preliminary experiments have been quite satisfactory.

The Siemens-Martin process of producing steel from crude wrought-iron and cast-iron is in successful operation at the Trenton Iron Works, under the superintendence of Mr. Frederick J. Slade.

In Auburn, N. Y., the water is distributed to the houses by means of powerful forcing-pumps, instead of the pressure from a high reservoir. The system originated with Mr. B. Holly of Lockport.

R. W. Raymond, U. S. Mining Commissioner, is busy in preparing his report to the Congress now in session. While he has the literary ability of his predecessor, Hon. J. Ross Browne, he has the higher qualification of scientific expertness in his subject.

We were in error in our last issue, in stating that Prof. A. M. Edwards had succeeded Prof. Stone in the Medical College for Women. Mr. Edwards is Prof. of Chemistry in the Woman's Medical College of the N. Y. Infirmary. The present is the first session of the latter institution.

TO CORRESPONDENTS.

E. Test, of Ind. writes:—"If phosphorus in small pieces be added to a boiling concentrated solution of sulphate of copper, a black solid compound will be formed, which, placed in contact with cyanide of potassium (in lumps) under water, yields phosphuretted hydrogen (or some other spontaneously inflammable compound of phosphorus) in abundance.

"Will some chemist be kind enough to state what compound is formed when the phosphorus is added to the sulphate of copper solution, and also what reactions take place when this compound is placed in contact with cyanide of potassium?"

T. D. of O.—Soda and carbonates of soda, are manufactured from cryolite at Natrona, Pa. The manufacture from salt has several times been attempted in America, and abandoned.

R. S. A. of Conn.—The English edition of Gmelin is not yet completed; it is expected that two volumes more are to be published. Watts' Dictionary we consider almost indispensable.

G. H. L. of N. Y.—It is not likely that the new edition of Fownes Chemistry will be reprinted here. Letheby's Lectures are to be republished by Townsend & Adams.

DRUGS AND CHEMICALS.

DRUGS AND CHEMICALS.				Burgundy Pitch, true.			
Acetone	per oz	to	85	Cadmium, Bromide	per oz	to	55
Acid, Acetic, No. 8.	per lb	to	35	Iodide	per oz	to	70
sp. gr. 1.047 U.S.P.	per lb	to	23	Metallic	per lb	to	4 60
Chemically Pure.	per lb	to	55	Sulphate	per lb	to	8 00
Glacial	per lb	to	1 60	Caffeine	per oz	to	9 50
Benzole, German	per oz	to	85	Calcium Chloride	per lb	to	90
Boracic, pure	per lb	to	85	Iodide	per lb	to	8 50
Citric	per lb	to	1 35	Calomel, Hydrosul.	93	to	1 00
Fluoric, 1 lb bottles	per lb	to	3 30	Camphor, Refined	per lb	to	1 25
Formic	per lb	to	3 50	Cannella Alba	per lb	to	16
Gallie	per lb	to	4 00	Cantharides, powdered	per lb	to	1 80
Hydro-phosphorous	per lb	to	4 25	Carbolic Acid crystals	per oz	to	17
Lactic	per lb	to	4 25	" " solution	per lb	60	85
Muriatic, 18 degrees	per lb	to	5	" " common	per lb	to	85
chemical pure	per lb	to	88	Carbon Bi-Sulphuret	per lb	to	38
Nitric, 38 degrees	per lb	to	15	Cascarilla Bark	per lb	to	14
chemical pure	per lb	to	88	Cassa Buds	per lb	1 10	1 15
Oxalic, patent	per lb	to	85	Castor Oil	per gal	2 75	2 80
Phosphoric, glacial	per lb	to	3 00	Caustic Soda	per lb	8 1/2	9
Prussic	per oz	to	13	Centaur Minor	per lb	to	38
Sulphuric	per lb	to	5	Cerium, Oxalate	per oz	to	1 60
chemical pure	per lb	to	50	Nitrate	per oz	to	1 75
Valerian	per oz	to	1 40	Chalk, Precip., English	per lb	to	23
Tartaric, powdered	per lb	to	78	Cherry Laurel Water	per lb	to	58
Aconite Leaves	per lb	to	28	Chlorate Potass, English	per lb	to	52
Aconitia	per dr	to	5 00	Chloride Lime	per lb	to	8
Agaric Alba	per lb	to	80	Chloroform	per lb	1 55	1 60
Alcohol, 95 per ct.	per gal	to	3 40	Cinnamon, Ceylon, true	per lb	to	1 75
Aloes, Cape, powdered	per lb	to	83	Citrine Ointment	per lb	to	58
Socotrine, powdered	per lb	to	1 25	Civet	per oz	to	5 50
Alcm, Roman	per lb	to	11	Cobalt	per lb	to	23
lump	per lb	to	4 1/2	Cocculus Indicus	per lb	to	34
Ambergris, gray	per oz	to	14 00	Cocoa Butter	per lb	to	1 10
Ammonia Carbonate, bulk	per lb	to	23	Codine	per dr	to	2 50
in jars	per lb	to	34	Cod Liver Oil	per gal	to	2 85
Muriate	per lb	to	16	Cod Liver Oil, ("Shore Oil")	per gal	to	2 25
Ammonia Aqua, 20 degrees	per lb	to	13	Cod Liver Oil, J. C. Baker & Co.'s	per doz	to	8 00
26 degrees	per lb	to	23	" " " 5 gross	per gross	to	90 00
Hypophosphite	per lb	to	4 25	Cod Liver Oil, Hazard & Caswell's	per doz	to	87 00
Oxalate	per lb	to	2 25	Collodion	per lb	to	7 50
Phosphate	per lb	to	3 00	Cantharidal	per doz	to	90 00
Sulphate	per lb	to	10	Colocynth, powdered	per lb	to	1 70
Ammonium Valerian. Crystals	per oz	to	1 60	Confectio Rosae	per lb	to	4 50
Ammonium Bromide	per lb	to	4 00	Sennae	per lb	to	85
Hydrosulphuret	per lb	to	75	Conium Leaves	per lb	to	48
Iodide	per lb	to	10 00	Coniin	per oz	to	48
Amygdalin	per oz	to	3 75	Copper Ammoniated	per lb	to	25
Antimony and Potass	per lb	to	1 10	Black Oxide	per lb	to	7 50
Butter	per lb	to	30	Carbonate	per lb	to	1 90
Arnica Leaves	per lb	to	20	Sulphur, pure	per lb	to	2 90
Arrow Root, Bermuda	per lb	to	60	Copperas	per lb	to	38
St. Vincent	per lb	to	18 30	Corrosive Sublimate	per lb	to	4
Arsenic, white powdered	per lb	to	8	Creosote Sublimate	per lb	to	92
red pulv	per lb	to	35	Cream Tartar, powdered, pure	per lb	48	50 1/2
red, lump	per lb	to	30	Cubebs	per lb	to	85
Arsenic Solution, Fowler's	per lb	to	17	Cubebin	per dr	to	25
Iodide	per oz	to	90	Cuttlefish Bone	per lb	23	30
Sol, Donovan's	per lb	to	38	Digitalis Herb	per lb	to	18
Asbestos	per lb	to	15	Digitaline	per dr	to	3 65
Asparagin	per oz	to	3 50	Dover's Powder	per lb	2 75	3 00
Atropa	per dr	to	3 50	Dragon's Blood, mass.	per lb	to	1 00
Sulphate	per dr	to	3 00	reeds	per lb	to	1 15
Valerian	per dr	to	4 50	Du'camara Stems	per lb	to	13
Balsam Fir	per gal	to	4 75	Emetine	per oz	to	8 65
Copaiba	per lb	to	98	Emery Corn	per lb	to	10
Peruvian	per lb	to	5 00	Flour	per lb	7 1/2	8
Tolu, true	per lb	to	1 85	Epsom Salts	per lb	to	4
Barbadoes Tar	per lb	to	12 1/2	Ergot, new	per lb	to	1 50 1/2
Bark, Elm	per lb	to	18	Ergotine	per oz	to	1 15
Bark, Calisaya, quill	per lb	to	1 60	Ether, Aesthetic	per lb	to	85
Red, quill	per lb	to	1 85	Butyric, concentrated	per lb	to	4 10
Pitayo	per lb	to	30	Butyraceous	per lb	to	1 75
Cascarilla	per lb	to	14	Chloro	per lb	to	85
Mesereon	per lb	to	23	concentrated	per lb	to	1 05
Sassafras	per lb	to	11	Formic	per lb	to	4 15
Baryta Muriate	per lb	to	30	Sulphuric	per lb	to	85
Nitrate	per lb	to	40	washed	per lb	to	95
Bay Rum	per gal	to	3 75	concentrated	per lb	to	1 05
Bebeerin, pure	per oz	to	5 50	Extr. Jockey Club, Chirls	per lb	to	8 65
Sulphate	per oz	to	3 53	Extr. Ess. Bouquet, Chirls	per lb	to	8 75
Belladonna Leaves	per lb	to	25	Extr. Banana, superior	per lb	to	1 25
Bicarbonate Soda	per lb	to	8	Extr. Orange, superior	per lb	to	1 25
Bichromate Potash	per lb	to	21	Fluor Spar	per lb	to	16
Bismuth Metallic	per lb	to	8 50	Flowers, Althaea	per lb	to	23
and Ammonia Citrate soluble	per oz	to	85	Arnica	per lb	to	28
and Ammonia Citrate Solution	per lb	to	1 80	Borago	per lb	to	95
Oxychloride	per lb	to	7 50	Chamomile, German	per lb	to	35
Subcarbon	per lb	to	8 50	Chamomile, Roman, 1867	per lb	to	52
Sub-Nitrate	per lb	to	8 00	Lavender	per lb	10	11
Tannate	per oz	to	1 50	Malva, large	per lb	35	40
Valerianate	per oz	to	2 40	small	per lb	to	45
Black Drops	per lb	to	5 00	Rosemary	per lb	to	70
Blue Mass	per lb	to	53	Tillae	per lb	to	70
Boie, Armenia, true	per lb	to	10	Violet	per lb	to	65
Brax, refined	per lb	to	10	Fusel Oil, purified	per lb	to	2 25
Boristone, roll	per lb	to	4	Ferro-Phosphated Elixir of	per doz	to	12 50
Bromine	per lb	5 1/2	to 6	Bark, Hazard & Caswell's	per doz	to	12 50
Brucia	per oz	to	3 75	Gamboge	per lb	to	2 1/2
Buchu Leaves, long	per lb	to	50	Galatina French Pink	per lb	to	1 1/2
short	per lb	to	24				

Gelatine, White French.....	per lb	85	to	1 15	Lime, Carbonate, Precipitate.....	per lb	to	22	
Cox's.....	per doz		to	2 50	Hypophosphite.....	per lb	to	4 00	
Ginger, Jamaica, bleached.....	per lb		to	82	Iodide.....	per lb	to	8 50	
Ginseng.....	per lb	80	to	85	Phosphate, Precipitate.....	per lb	to	40	
Glauber Salts.....	per lb	8	to	4	Sulphite.....	per lb	to	81	
Glycerine, common.....	per lb		to	25	Lime Juice.....	per gal	to	80	
concentrated.....	per lb		to	50	Lint, Taylor's.....	per lb	to	1 80	
"Bowers".....	per lb		to	80	Lapis Calaminaris.....	per lb	to	8	
"Price's".....	per lb		to	1 20	Laurel Berries.....	per lb	to	12	
Glycerole Hypophosphite.....	per lb		to	1 75	Leaves.....	per lb	to	12	
Grains D'Ambrette.....	per lb		to	60	Liquid Styra.....	per lb	to	60	
Paradise.....	per lb		to	85	Long Pepper.....	per lb	to	90	
Gum Acroides.....	per lb		to	24	Lunar Caustic, pure.....	per oz	to	1 20	
Amber.....	per lb		to	50	87 per cent, N. S.....	per oz	to	90	
Ammoniac.....	per lb	60	to	75	Lycopodium.....	per lb	to	70	
Arabic, Turkey, sorts.....	per lb		to	45	Magnesia Carbonate.....	per lb	to	45	
1st picked, Trieste.....	per lb		to	95	Calcined.....	per lb	95	to	1 20
2d ".....	per lb	70	to	75	ponderous.....	per lb	to	1 80	
3d ".....	per lb	50	to	55	Cltrate.....	per lb	to	1 75	
Barbary.....	per lb		to	40	Sulphite.....	per lb	to	1 20	
Asafoetida.....	per lb	48	to	50	Manganese, powdered.....	per lb	t.	8	
Benzoin, common.....	per lb		to	90	Saxony.....	per lb	to	12	
prime.....	per lb	1 00	to	1 10	Manna, small flake, '67.....	per lb	to	1 70	
white marbled.....	per lb	1 10	to	1 15	large flake, '67.....	per lb	to		
Copal, Acera.....	per lb		to		sorts, new.....	per lb	to	1 45	
Benguela.....	per lb		to	85	Matteo Leaves, true.....	per lb	to	50	
Kowrie.....	per lb		to	45	Mercury.....	per lb	t.	85	
[Damar, Batavia.....	per lb		to	50	cum Cresta.....	per lb	to	54	
Singapore.....	per lb		to	45	Magnesia.....	per lb	to	1 22	
Elemi, Aromatic.....	per lb		to	45	Cyanuret.....	per lb	to	5 80	
Euphorbium.....	per lb		to	25	Sulphuret.....	per lb	to	80	
Galbanum.....	per lb		to	95	Mercurial Ointment (1/2 M).....	per lb	to	65	
strained.....	per lb		to	1 00	(1/2 M).....	per lb	to	55	
Gedda.....	per lb		to	23	Mo-phia Sulphate.....	per oz	to	15 50	
Gualacum.....	per lb	50	to	65	Acetate.....	per oz	to	15 50	
strained.....	per lb		to	75	Muriate.....	per oz	to	15 50	
Kino.....	per lb		to	1 10	Valerianate.....	per oz	to	16 00	
Mastic.....	per lb		to	4 25	Musk, true.....	per oz	to	16 00	
Myrrh, Turkey, powdered.....	per lb		to	75	In grain true.....	per oz	to	32 00	
Olibanum.....	per lb		to	80	Nux Vomica.....	per lb	to	18	
tears.....	per lb		to	40	Oil, Amber, Crude.....	per lb	to	80	
Sandarac.....	per lb		to	65	Almonds (Expressed) Allen's.....	per lb	to	95	
Shellac, Campbell's D. C.....	per lb		to	60	Essential, Allen's.....	per lb	to	22 00	
Garnet.....	per lb		to	55	Anise.....	per lb	to	4 25	
No. 2.....	per lb	48	to	50	Bergamot.....	per lb	6 00	to	7 00
Native.....	per lb	48	to	50	FF, new crop.....	per lb	to	6 50	
Senegal.....	per lb		to	50	Bergamot, Donner's.....	per lb	6 75	to	7 00
Tragacanth, common.....	per lb		to	85	Bergamot, —Sanderson's.....	per lb	6 75	to	7 00
flake.....	per lb	1 80	to	1 50	Cado.....	per lb	to	1 00	
fluky sorts.....	per lb		to	60	Cajuput.....	per lb	to	2 00	
Harlem Oil, Dutch.....	per doz		to	50	Camphor.....	per lb	to	1 75	
Hoffman's Anodyne.....	per lb		to	84	Caraway.....	per lb	to	2 75	
Hydriodate Potash, Atkinson's.....	per lb		to	5 60	Seed.....	per lb	to	5 50	
Conrad's.....	per lb		to	5 45	Cassia.....	per lb	to	4 00	
Hyoscyami Leaves.....	per lb		to	26	Cinnamon, true.....	per oz	to	1 50	
Hypophosphite Ammon.....	per lb		to	4 25	Citronella, prime.....	per lb	to	2 25	
Iron.....	per lb		to	8 50	Winter's.....	per lb	to	3 50	
Lime.....	per lb		to	4 50	Copaiva.....	per lb	to	3 00	
Manganese.....	per lb		to	14 00	Croton.....	per lb	to	4 25	
Potash.....	per lb		to	4 40	Cubeba.....	per lb	to	4 50	
Soda.....	per lb		to	4 40	Cumin.....	per lb	to	10 00	
Iceland Moss.....	per lb	10	to	12	Fennel.....	per lb	to	8 00	
Indian Hemp, true.....	per lb		to	1 00	Geranium.....	per lb	12 00	to	22 00
Insect Powder, true.....	per lb		to	1 15	Chirita.....	per lb	to	18 00	
Iodine, Resublimed.....	per lb		to	6 75	Prepared.....	per lb	to	25 00	
Crude, in bulk.....	per lb		to	6 50	Turkish.....	per lb	14 00	to	18 00
Irish Moss.....	per lb		to	10	Jessamine.....	per lb	to	3 50	
Iron, Alum.....	per lb		to	1 60	Juniper.....	per lb	to	1 90	
by Hydrogen.....	per lb		to	2 80	Berries, true.....	per lb	to	3 50	
Carb. Proto.....	per lb		to	45	Lavender, Garden, forte.....	per lb	to	1 85	
Precip.....	per lb		to	25	fine.....	per lb	to	3 75	
Cltrate and Ammonia.....	per lb		to	1 45	Flowers, Chirita, No. 1.....	per lb	to	1 00	
Magnesia.....	per lb		to	1 85	Lavender Spike.....	per lb	to	90	
Quinine.....	per lb		to	10 00	Laurel, Expressed.....	per lb	to	4 50	
Strychnine.....	per lb	10 00	to	12 50	Lemon, Donner's.....	per lb	to	4 50	
Hypophosphite.....	per lb	8 40	to	8 50	Lemon, —G. R. & Co's.....	per lb	to	4 45	
Iodide.....	per lb		to	8 25	—Sanderson's (new).....	per lb	to	7 00	
Syrup.....	per lb		to	80	Lemongrass, —Winter's.....	per lb	to	2 50	
Lactate.....	per lb		to	3 25	Mace, Expressed.....	per lb	to	1 75	
Phosphate, Precipitate.....	per lb		to	67	Marjoram.....	per lb	to	3 00	
Pyrophosphate.....	per lb		to	1 15	Myrrbane.....	per lb	to	5 00	
Syrup.....	per lb		to	65	Neroli Bigarade.....	per oz	to	5 00	
Sesquichloride.....	per lb		to	1 45	Chirita.....	per oz	to	28 00	
Sol.....	per lb		to	44	Petit Grain.....	per gal	to	3 25	
Sesquinitrate.....	per lb		to	60	Olive, pure.....	per box	to	6 00	
Subsulphate.....	per lb		to	1 70	Marseilles, quarts.....	per box	to	7 25	
Sulphate, pure.....	per lb		to	9	pints.....	per box	to	4 25	
Exalcat.....	per lb		to	17	Orange.....	per lb	75	to	1 50
Sulphuret.....	per lb		to	81 1/2	Origanum.....	per oz	to	4 00	
Supersulphate Syrup.....	per lb		to	63	Patchouly.....	per lb	8 75	to	4 00
Tannate.....	per lb		to	6 60	Pennyroyal.....	per oz	to	5 50	
India Ink.....	per lb		to	1 75	Peppermint, pure.....	per lb	to	10 00	
Isinglass, American.....	per lb		to	1 55	Rhodium.....	per oz	to	11 00	
Ruskin, true.....	per lb	6 50	to	6	Rose, Kissanlick.....	per lb	to	1 75	
Juniper Berries.....	per lb	4 1/2	to	3 75	Rosemary, French.....	per lb	to	1 15	
Juniper Tar Soap, Hazard & Caswell's.....	per doz		to	1 20	Trieste.....	per lb	to	2 25	
Kresote, white.....	per lb		to	75	Chirita.....	per lb	to	2 00	
Lactacarium.....	per oz		to	1 00	Sabine, pure.....	per lb	to	1 00	
Lead Acetate, pure.....	per lb		to	43	Sassafras, cans.....	per lb	to	2 50	
Leucorice Paste, solid.....	per lb		to	30	Sesame, Salad, fine.....	per lb	to	2 50	
Italy.....	per lb		to	48	Spearmint, Hotchkiss.....	per lb	6 50	to	
Imitation.....	per lb		to	87	Spike.....	per lb	to	60	
Baracco.....	per lb		to	50	Succinum, crude.....	per lb	to	60	
P. S.....	per lb		to	50	re-tified.....	per lb	to	70	
					Tanzy, —"Eastman's".....	per lb	to	6 00	

Oil Thyme, white, pure	per lb	to 2 75
Valerian	per lb	to 18 00
Wintergreen	per lb	to 4 75
Wintergreen, Van Dusen Bros.	per lb	to 4 75
Wormwood	per lb	to 7 25
Wormseed, Western	per lb	to 2 75
Baltimore	per lb	to 8 50
Black Pepper	per lb	to 1 25
Oregano	per oz	to 8 50
Ergot	per oz	to 25
Opium	per lb	to 22 00
Orange Buds or Apples	per lb	to 18
Cassia Elib.	per lb	to 23
Otto Rose, pure	per oz	to 11 00
commercial	per oz	to 7 50
Peppers, Zansibar	per lb	to 83
Phosphorus	per lb	to 1 10
Amorphous	per lb	to 8 25
Piperin	per oz	to 1 60
Podophyllin	per oz	to 50
Poppy Heads	per lb	to 25
Potassa	per lb	to 85
Acetate	per lb	to 48
Bicarbonate	per lb	to 25
Carbonate	per lb	to 65
Caustic, common	per lb	to 95
white	per lb	to 1 15
Citrate	per lb	to 75
cum Calce.	per lb	to 4 25
Hypophosphite	per lb	to 80
Permanganate, ordinary	per lb	to 2 75
Phosphate	per lb	to 44
Prussiate	per lb	to 16
Sulphate	per lb	to 1 05
Tartrate	per oz	to 3 75
Potassium	per lb	to 2 50
Bromide	per lb	to 83
Cyanide, fus	per lb	to 1 25
gran	per lb	to 5 50
Iodide	per lb	to 85
Sulphuret	per lb	to 85
Quinine, Citrate, with Iron	per oz	to 2 40
Sulphate, American	per oz	to 2 25
French	per lb	to 7
Quassia, rasped	per lb	to 7
Red Chalk Fingers	per lb	to 1 15
Red Precipitate	per lb	to 23 00
Resin of J-lap, pure	per lb	to 48
Rochelle Salt	per lb	to 24
Rosin	per lb	to 17
Alkanet	per lb	to 23
Alkha	per lb	to 85
Angelica	per lb	to 20
Calamus	per lb	to 20
Colchicum	per lb	to 20
Colombo	per lb	to 24
Culveris	per lb	to 23
Dandelion	per lb	to 12
Galangal	per lb	to 10
Gentian	per lb	to 20
Ginger, Race, African	per lb	to 23
Jamaica, Bleached	per lb	to 30
Golden Seal	per lb	to 16
Hellebore black	per lb	to 65
white, powdered	per lb	to 8 00
Ipecacuanha	per lb	to 2 25
powdered	per lb	to 2 25
Jalap	per lb	to 13
Licorice	per lb	to 15
Mandrake	per lb	to 16
Orria, Florentine	per lb	to 14
Verona	per lb	to 38
Pink	per lb	to 30
Rhatany	per lb	to 4 00
Rhubarb, E. I.	per lb	to 24 00
Turkey	per lb	to 52 1/2
Sarsaparilla, Honduras	per lb	to 80
Mexican	per lb	to 60
Turbeth	per lb	to 65
Valerian, English	per lb	to 40
Dutch	per lb	to 26
German	per lb	to 40
Vermont	per lb	to 75
Snake, Virginia	per lb	to 80
Seneca	per lb	to 2 25
Rose Leaves	per lb	to 12
Rosemary Leaves	per lb	to 10
Rubigo Ferri	per lb	to 2 25
Saffron, American, new	per lb	to 17 00
Spanish, true	per lb	to 12
Sago, Pearl	per oz	to 60
Sallin	per lb	to 53
Sal Acetosella	per lb	to 16
Ammoniac	per lb	to 6
Soda, Newcastle	per lb	to 1 80
Santonine	per oz	to 15
Sassafras Bark	per lb	to 20 00
Scammony, virg., true	per lb	to 23
Seeds, Anise	per lb	to 55
star	per bush	to 5 25
Canary, Dutch	per bush	to 5 25
Smyrna	per lb	to 5 00
Cardamom, Malabar	per lb	to 23
Carul	per lb	to 65
Celery	per lb	to 65

Seeds, Clover	per lb	to 16
Colchicum	per lb	to 24
Coriander	per lb	to 17
Cummin	per lb	to 20
Fennel	per lb	to 20
Fennugreek	per lb	to 12
Hemp	per bush	to 2 65
Linseed, American clean	per tierce	to 2 50
rough	per bush	to 2 50
Bombay (gold)	per bush	to 2 55
Calcutta (gold)	per bush	to 16
Mustard, brown	per lb	to 16
white	per lb	to 5 25
Rape	per bush	to 5 00
Timothy	per bush	to 23
Worm	per lb	to 43
Seidlitz Mixture	per lb	to 23
Senna, Tinnevely	per lb	to 50
Alexandria	per lb	to 23
E. I.	per lb	to 23
Smalts, Blue	per lb	to 78
Suif, Lorillard's Maccaboy	per lb	to 1 00
Coarse Rappee	per lb	to 85
Irish High Toast	per lb	to 85
Fresh Scotch	per lb	to 13
Soap, Castile, Mottled	per lb	to 25
White	per lb	to 25
floating	per gra	to 15 50
Low's Brown Windsor	per lb	to 80
Soda Acetate	per lb	to 2 15
Chlorate	per gal	to 45
Chloride, Liquor	per lb	to 1 00
Citrate	per lb	to 1 05
Hydrosulphate	per lb	to 4 10
Hypophosphite	per lb	to 10
Hyposulphite	per lb	to 22
Nitrate, pure	per lb	to 21
Phosphate	per lb	to 1 25
Pyrophosphate	per lb	to 23
Sulphite	per lb	to 4 1/2
Ash	per lb	to 11 00
Sodium	per lb	to 8 00
Iodide	per lb	to 55
Spirit Ammonia	per lb	to 60
Aromatic	per lb	to 55
Lavender	per lb	to 45
Nitre Dulo	per lb	to 60
Rosemary	per lb	to 80
Sponges, Bahama	per lb	to 4 00
Bathing, Formes	per lb	to 60
Coarse Brown	per lb	to 7 00
Fine, medium	per lb	to 7 00
Surgeon's	per lb	to 8 00
Zimoca	per lb	to 20 00
Cup, Turkey	per lb	to 12 00
Trieste	per lb	to 15 00
Fine Toilet, bleached	per lb	to 4 50
Fine Trieste, small	per lb	to 1 75
Glove	per lb	to 25
Grass	per lb	to 1 40
Sheep's wool	per lb	to 5 50
Sur Choix	per lb	to 12
Squills	per lb	to 30
St. John's Bread	per lb	to 30
Strontia, Muriate	per lb	to 80
Nitrate	per lb	to 1 80
Oxalate	per oz	to 3 75
Strychnia, Acetate	per oz	to 75
Citrate	per oz	to 3 75
Nitrate	per oz	to 3 50
Pure, crystallized	per oz	to 3 25
powdered	per oz	to 3 75
Sulphate	per oz	to 5 50
Valerianate	per oz	to 55
Styrax Calamita	per lb	to 42
Sugar of Lead	per lb	to 58
Sugar of Milk	per lb	to 7
Sulphur Sublime	per lb	to 10
Tamarinds	per lb	to 3 75
Tannin	per lb	to 14
Taploca, East India, white	per lb	to 16
Pearl	per lb	to 95
Tartar Emetic, powdered	per lb	to 1 15
crystallized	per lb	to 45
Tin Foll, thin	per lb	to 70
French, No. 15	per lb	to 40
Tobacco	per lb	to 65
Tonqua Beans, Para	per lb	to 87 1/2
Augustora	per lb	to 12
Uva Ural, American	per lb	to 18
French	per lb	to 11 00
Vanilla Beans, Bourbon	per lb	to 15 00
Mexican	per lb	to 30
Venice Turpentine	per oz	to 5 25
Veratria	per lb	to 11
Vitriol, Blue	per lb	to 2
Green	per lb	to 9
White	per lb	to 75
Wax, White, J. I. Elkens	per lb	to 75
No. 2	per lb	to 75
Phillips'	per lb	to 2
Yellow	per lb	to 2
White Wax, Leonhardt's	per lb	to 2
Ockmid	per lb	to 2
Sun-bleached	per lb	to 2

White Precipitate.....	per lb	to 1 55
White Pepper.....	per lb	to 58
Wine, Colchicum Seeds.....	per lb	to 1 40
Wood Naphtha.....	per lb	to 85
Wormwood Herb.....	per lb	to 25
Yellow Bark.....	per lb	to 80
Dock.....	per lb	to 25
Zaffre.....	per lb	to 1 15
Zinc, Acetate.....	per lb	to 1 25
Chloride.....	per lb	to 1 80

DYES AND DYESTUFFS.

Aniline Blue.....	per lb	to 7 50
Red.....	per lb	to 6 00
Violet.....	per lb	to 7 50
Annatto.....	per lb	1 00 to 1 75
Cochineal, Honduras.....	per lb	to 1 40
Mexican.....	per lb	1 30 to 1 40
Cudbear.....	per lb	48 to 45
Cutch, Pegus.....	per lb	to 18
Gambler.....	per lb	to 8
Indigo, Bengal, fine.....	per lb	to 8 25
good.....	per lb	2 50 to 2 75
middling.....	per lb	2 00 to 2 10
Madras, fine.....	per lb	1 60 to 1 65
ordinary.....	per lb	1 00 to 1 25
Kuprah.....	per lb	to 2
Guatemala.....	per lb	2 00 to 2 10
Caracas.....	per lb	to 1 65
Lac Dye, good to fine.....	per lb	55 to 60
Logwood, Campeachy.....	per lb	to 2 1/2
Honduras.....	per lb	to 2 1/2
Jamaica.....	per lb	to 2 1/2
Laguna.....	per lb	to 2 1/2
St. Domingo.....	per lb	to 2
Extract.....	per lb	18 to 16 1/2
" in bulk.....	per lb	12 1/2 to 13
Lima Wood (gold).....	per bbl	70 00 to 71 00
Madder, Dutch.....	per lb	23 to 24
French.....	per lb	23 to 25
Nutgalls, Blue, Aleppo.....	per lb	40 to 42
Orehille.....	per lb	80 to 85
Persian Berries.....	per lb	50 to 55
Safflower.....	per lb	60 to 65
Sapanwood.....	per lb	19 to 15
Turmeric.....	per lb	15 to 16
Ultramarine.....	per lb	23 to 45
Wood.....	per lb	15 to 16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials.....	50	percentage	discount.
German Flint Bottles and vials.....	30	"	"
Flint Bottles and vials.....	25	"	"
Furniture Ware.....	10	"	"
Perfumer's Ware.....	25	"	"
Chemical Ware.....	net	"	"
Syringes.....	10	"	"
Homoeopathic vials.....	10	"	"

NAVAL STORES.

Pitch, City.....	per bbl	to 4 00
Resin, Extra Pale.....	per 280 lbs	8 00 to 7 00
Pale.....	"	7 00 to 5 00
No. 1.....	"	5 00 to 4 00
No. 2.....	"	4 00 to 4 00
Strained.....	"	4 00 to 3 75
Common.....	"	3 75 to 3 00
Spirits, Turpentine (North Carolina).....	per gal	55 to 50
Turpentine, Soft.....	per 280 lbs	to 8 00

OILS.

Linseed Oil, American.....	per gal	to 1 10
English.....	per gal	to 1 10
Palm Oil.....	per lb	to 15
Paraffine Lubricating Oil.....	per gal	to 40
Sperm, Crude.....	per gal	to 2 30
Sperm, Winter, unbleached.....	per gal	to 2 30
Lard Oil, Prime, City.....	per gal	to 1 80
Red Oil, City distilled.....	per gal	to 70
Red Oil, Saponified.....	per gal	to 78
Whale, Crude.....	per gal	to 1 15
Whale, Bleached, Winter.....	per gal	to 1 25

PAINTS (DRY).

Asphaltum, opt.....	per lb	to 7
Barytes, Foreign.....	per ton	to 45 00
Barytes, American.....	per lb	to 2
Black Lead.....	per lb	8 to 12
Black Ivory, drop, fair.....	per lb	10 to 13
good.....	per lb	18 to 20
best.....	per lb	24 to 28
Blue Celestial, good.....	per lb	to 14
Chinese.....	per lb	to 1 00
Prussian, fair to best.....	per lb	85 to 1 00
Ultramarine, fair to best.....	per lb	23 to 45
Chalk, Lump.....	per lb	to 2 1/2
China Clay.....	per lb	to 2 1/2
".....	per bbl	to 4 50
" Paris, fair to best.....	per lb	85 to 50
" Chrome, fair to best.....	per lb	88 to 42
" Black-Coach Painter's—L. Martin & Co. h.....	per lb	28 to 25

Lamp Black, ordinary.....	per paper	8 to 12
Litharge, powdered, American & English.....	per lb	11 to 11 1/2
Ochre, Yellow, French, dry.....	per lb	2 1/2 to 4
Red Venetian.....	per lb	3 1/2 to 5
Red Indian, fair to best.....	per lb	11 to 18
Red Lead, American.....	per lb	11 to 12
English.....	per lb	14 to 15
Rose Pink.....	per lb	18 to 20
Sienna, American.....	per lb	7 to 9
Italian, Bnt.....	per lb	18 to 22
Raw.....	per lb	15 to 20
Umber, Crude, Turkey.....	per lb	5 to 7
burnt.....	per lb	8 to 9
Tieinan's Calif. Vermilion.....	per lb	to 1 10
Pure Carmine.....	per lb	to 16 00
Soluble Blue.....	per lb	to 1 25
Vermilion, English, pale.....	per lb	to 1 25
deep.....	per lb	to 1 20
American.....	per lb	to 85
Chinese.....	per lb	to 1 30
Trieste.....	per lb	to 1 20
White, China.....	per lb	to 22
Cremnits.....	per lb	to 80
Lead, pure.....	per lb	18 to 14
good.....	per lb	9 to 11 1/2
Paris.....	per lb	3 1/2 to 4
Zinc, American.....	per lb	10 to 12 1/2
Zinc, French.....	per lb	14 to 16
Whiting.....	per lb	8 1/2

PAINTS (IN OIL).

Black coach.....	per lb	28 to 30
Blue, Chinese.....	per lb	90 to 1 00
Prussian, fair to best.....	per lb	85 to 80
Brown, Van Dyke, fair to best.....	per lb	20 to 28
Dryer, Patent, American.....	per lb	12 1/2 to 14
English.....	per lb	12 1/2 to 15
Green, Chrome.....	per lb	18 to 27
Imperial.....	per lb	15 to 18
Paris.....	per lb	28 to 42
Verdigris.....	per lb	25 to 63
Patty, in bladders.....	per lb	5 1/2 to 6
in bulk.....	per lb	5 1/2 to 5 1/2
Red Venetian, fair to best.....	per lb	8 to 16
Sienna, burnt, fair to best.....	per lb	22 to 25
White Lead, English, B. B.....	per lb	to 16
American, pure.....	per lb	18 1/2 to 14
good.....	per lb	11 to 12 1/2
fair.....	per lb	9 to 10
White Zinc, American.....	per lb	10 to 12
French.....	per lb	15 to 15 1/2
Yellow Ochre.....	per lb	9 to 10
Chrome, fair to best.....	per lb	16 to 22

SPICES.

Cassa, in mats.....	per lb	to 84
Cloves.....	per lb	to 46
Ginger, Race, African.....	per lb	to 19
Mace.....	per lb	to 1 55
Nutmegs, No. 1.....	per lb	to 1 45
Pepper.....	per lb	to 88
Pimento, Jamaica.....	per lb	to 84

WINDOW GLASS.

American Window—1st, 2d, 3d and 4th qualities.

6 by 8 to 8 by 10.....	Per fifty feet \$	6 25 to 8 75
8 by 11 to 10 by 15.....	"	6 75 to 4 75
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 18 to 16 by 24.....	"	8 50 to 6 00
20 by 30 to 24 by 30.....	"	10 00 to 7 00
24 by 36 to 28 by 36.....	"	12 50 to 8 00
28 by 40 to 32 by 40.....	"	14 00 to 9 00
32 by 48 to 36 by 48.....	"	16 00 to 10 00
36 by 54 to 40 by 54.....	"	18 00 to 14 00
40 by 60 to 44 by 60.....	"	20 50 to 16 00
44 by 68 to 48 by 68.....	"	24 00 to 18 00
48 by 72 to 52 by 72.....	"	26 00 to 21 00

The above is subject to a discount of 25 per cent.

French Window—1st, 2d, 3d and 4th qualities. (Single thick.)

6 by 8 to 8 by 10.....	Per fifty feet \$	6 25 to 4 75
8 by 11 to 10 by 15.....	"	6 75 to 5 00
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 18 to 16 by 24.....	"	8 50 to 6 00
20 by 30 to 24 by 30.....	"	10 00 to 7 00
24 by 36 to 28 by 36.....	"	12 00 to 8 00
28 by 40 to 32 by 40.....	"	14 00 to 9 00
32 by 48 to 36 by 48.....	"	16 00 to 10 00
36 by 54 to 40 by 54.....	"	18 00 to 14 00
40 by 60 to 44 by 60.....	"	20 50 to 16 00
44 by 68 to 48 by 68.....	"	24 00 to 18 00
48 by 72 to 52 by 72.....	"	26 00 to 21 00

Subject to a discount of 20 per cent. English sells at 10 per cent. discount off the above rates.

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POPULAR SCIENCE.

"A LITTLE learning is a dangerous thing," and the less you have the more dangerous it is. It is dangerous for a man to be so far reduced in the knowledge of fire that he cannot obtain it without the friction of sticks, because in damp weather, or in the absence of suitable wood or strength, he may be able to get none at all. But it is still more dangerous if he loses even that little knowledge without any to supply its place; he may then despair of life. If great depths were the only places where strata of valuable learning were to be found, few would benefit, as few would be found willing to leave the bright sunshine and the light of the human countenance to burrow even among treasures. We value the experience obtained by the man who sinks 2,000 feet below the surface and brings up wealth, and we listen to him with pleasure. We have a similar interest in him who leaves his home and crushes quartz in a wild place for years to obtain gold, and we look with more or less reverence on the man who hides in his study and loses society in which he delights that he may bring out of darkness what truth he can find.

All these men benefit as a rule by their labours; they have a reward independent of their discoveries: but the world cares little for their work, although accompanied by a delight in nature, or in invigorating bodily exercise, or in mental feats, compared with the great gross result itself. The gold appears and circulates; it is a part of the world's stores passing to this man and leaving that one like the air itself, and the long years of study are summed up in a few lines in a penny newspaper. The gold buys bread without the knowledge of digging and stamping, and the once abstruse discovery becomes so plain that we wonder why the student was so long about it. Having lived so many years, did he do no more than that?

There are, however, men who seem to think that the knowledge of the amalgamation process ought to come before the knowledge of the shilling's value, and are unwilling that a boy should learn a language without passing through the same process of thought passed by the nation which spoke it, forgetting the centuries of its life and its millions of living beings who modified the speech, and the few hard years which the boy has in order to attain the same end. But time teaches firmly, and throws difficulties aside by making them impossible; so we cease to enquire if the gold came from Ophir in Solomon's ships or from New Zealand by the overland route, and we learn to speak our mother tongue little thinking of the terrible history of man during the time of its formation. No student could go over the history of a piece of gold if it were in plainest language, so long would it be; or if he could read long enough he would be little endowed with feeling if he could endure it. If we saw before us all the feelings exercised in forming some of our words we should be obliged to use but few, the pain of learning would be so great.

Knowledge is real, even if the weary head that first saw it lay down in despair on account of unrewarded labour; and gold is real if the mine is lost for ever to mankind. Who knows the origin of bread-making or of pot-boiling, or of the commonest modes of agriculture? We try to form their history, and move cautiously back towards its beginning, but we soon become as thorough-

ly lost as when we think of the beginning of time or of space. The useful arts are conditions under which we of this generation have appeared. We heard lately of a mining company in Spain which began operations in ground covered with *débris* of previous mining and smelting operations to an extent greater than we can show in any part of this country. The old workings are said to be very extensive, and pumping Archimedean screws are still *in situ* with statuettes at cross-roads, forming little chapels underground. We should like to hear more of these works and have the whole authenticated, but the heaps show already the amount of labour, and we see readily why so many vessels went to the west and why the apples themselves became to the ancients golden in such a land of wealth. The world allowed the whole to go to wreck, and believed the people to be fabulous, although the golden apples were there in abundance. The one was turned almost out of tradition, the other we have multiplied to commonness, as oranges. The great world takes what it pleases of the works of men. Generations labour for centuries to elucidate a truth, and the time comes when it appears so clear as to be taught in a few minutes. The human race, with a certain majesty which we may fairly call divine, treats equally the results of a thousand years and of one day.

When philosophers think and scientific men make experiments, observations, and calculations, their work receives admiration as occasion requires, but the name is most frequently forgotten or neglected. He is highly honoured indeed who fills up a whole line in an encyclopædia. It is true that occasionally some writer attracts the attention of the public to an individual, holding him up to the wondering world, and turning him round on all sides in a transparent biographical case, an intellectual translation of the method by which we examine bees at work in their glazed hives, astonished at the origin of their thoughts and the constancy and accuracy of their labour.

Sometimes we think it a pity that so many noble thinkers should be forgotten, but greatness is comparative. Even if our later ideas on the progress of man be incorrect, it is hard to imagine the number of men who must have given their minds to the improvement and cultivation of corn. We cannot count up the number that we have seen with our own eyes of ploughmen plodding homeward, participating in some experiment where success had been gained or was expected. As a sovereign of old who saw the people dig as one, whilst he also was one, and the more important, so tradition throws these endless agriculturists into a word and gives the honour of the discovery of corn to Ceres. We can afford under this word to give them a little amusing attention for a few hours of school days, feeling ourselves as superior to them all as a living dog to whole ages of dead lions; and why should we treat them differently? We habitually view even great worlds, suns, and systems, as objects so extremely trifling that numbers of them are required to give a slight whiteness to the sky, not visible except when the sun is absent, so trifling is the amount. We have a right to treat them all as comparatively unimportant, exactly as a child has a right to treat its nurse with more attention than any, however exalted, person that may claim its favour; an undeniable right derived from our inherent weakness and littleness. Everything in this busy world must take its place according to its value to us; we are the living dogs.

With the same absence of remorse we cut down discoveries, taking from long memoirs a few figures, and

throwing the rest into a kind of waste library, which we keep out of respect for the workmen, but which we never read. The great world cares not even to keep that, but burns it virtually as it has often burnt the accumulations really. To the world the great life of an old philosopher becomes a fable. Whom shall we pick out? say Pythagoras; he is simply, to most who have heard of him, the discoverer of a geometrical problem now well known. He thanked the gods for it by a sacrifice; some of us learn it, and few remember it. The world has left but small scraps of curious and interesting things regarding all the great men of Greece, but nevertheless this is one of the most complete illustrations of the diminished influence of the great, and of the manner in which their most important ideas dwindle. Even that little is now made into abstracts. It was a wonderful thing to discover the satellites of Jupiter, but we now look at them with opera glasses, and there are even men who say that they see them with the unaided eye. When Glauber made his *sal mirabile*, finding it of wonderful power in the vegetable kingdom, in medicine, and, indeed, "to all men of whatsoever state or condition," he little thought of the hundreds of thousands of tons to be made yearly, not for direct use, but simply as a stage on the way to the manufacture of a much more important substance, *soap*. We must not bring instances here when every encyclopædia is a proof of thousands, but we may recall to mind that sometimes the works of a man, after diminishing in magnitude to our own eyes, cease to appear altogether as discoveries, but become as simple truisms known to all men, and not to be claimed by any but quacks or adventurers. By a late treatment of Bacon's life the inductive philosophy slips from him entirely and from every other man also regarded as a founder. We still keep our respect for Bacon, but the world cares little which view is true, and probably believes after all that it would have reasoned quite as well if it had had no such training. Schools of philosophy, great for centuries, leave no trace to be seen, unless you examine the *débris* with a microscope. A few students do this and keep up the knowledge, but it gradually diminishes in their eyes, and they at last follow the example of the multitude which cares little for anything that has no rapidly available good in it. They think as the manufacturer did when an analysis was brought to him containing, among other items, a trace of sulphur. Trace! what is the use of a trace in a man's business?

As we see great things diminish into trifles or vagueness, so scientific discoveries, however much they seem for a while to fill the minds of thinking men, float lightly over the world; in other words, they become popular, and take their place at the fireside beside the interesting fairy tale and the still more interesting bread and butter. In a certain city of no small fame, in 1848, the people determined on a revolution. They met after breakfast and stormed much, but dinner-time came before they could get their work done and they went home. Of course they must dine. After dinner they required rest and a pipe and could not be collected, and so the opportunity was gone. Every event and idea interesting to man is reduced to the level of his habits, understandings, and capacity. It is made popular.

The machinery of discovery—that is, the working of the mind which discovers, is set aside, and the cream of everything is taken so far as it can be understood and fitted to man's present wants. Do not let us suppose that popular knowledge is merely a little of the least valuable; the people seize on the highest, and, for general purposes, best, and let scientific men blame

themselves in most cases if their work is not known to the public. The amount of scientific work done in Europe is beyond the ken of any man. Even profound scientific men are obliged to pick out the best in a popular way; the word popular having a meaning differing according to the man. Scientific journals exist professedly to abstract the best, and reviews and newspapers extract again and make clear; that which bears explanation without long study becomes popular. No magnitude repels the public; vastness is always attractive, but complicated studies require time, and these never can become popular whether small or great in value. The people seize the best they can use, and this is popular science. We read a book of long reasoning, and forget all but a few sentences as we think, but power remains. Popular science takes these few sentences. It says, We take the kernel and leave you the shell; we burn the coal, you go down the pit; we eat, you sow.

This popular science rules us, and, to a great extent, must always guide us. When public bodies discuss affairs which require knowledge of nature, how seldom do they seek aid of scientific men? They settle by popular science. If, however, they are opposed, they seek scientific men to prove them correct, not to teach them. This brings us to the actual difference between popular science and science properly so called. Now this may be viewed in many ways, but we shall take only such as serves for present purposes. In a stagnant state popular and profound science would give the same opinion. The advantage of the latter would be in its power to give a better reason, the true place of a fact would be better known to it in its relation to other facts; but in an advancing age the thorough scientific man has a still greater advantage. He has followed the science from the beginning through a long line of learning, and he knows therefore in what direction it is leading. He knows that there are dangers on one side, uncertainties on another, and aims at absolute certainty on a third. He sees to a certain extent in advance. Do not suppose that because we have looked with favour at the great position of popular science that we are inclined to speak slightly of the true student. If we did so, how foolish we should be! If the united worlds in the heavens sink down to a brightness so small as to be compared to inferior milk, it is not that we may despise, but it is rather that we may wonder more at the inconceivable distances that have produced such awful results. Nor does the world think of giving up its minuter science, but clings more and more to it, as it must find students again and again to go over the foundations of knowledge and keep up the building which has, unfortunately, in many points, been raised in the presence of a too small number of witnesses.

The popular mind knows everything in a way. No calculations trouble its serenity, no hard experiments, no long laborious readings, no weary attempts to make clear in words that which has rejoiced the heart and elevated the mind. It knows all sciences and arts, and really knows them wonderfully well. But who will trust it to do anything whatever requiring exact knowledge? If we give it a ship to build, could it pick out good wood or make good iron? There are but few that can do the latter, even with the aid of our best metallurgical treatises. Could the popular mind put the wood or iron in a proper shape? Could it rig the ship? Could it supply it with good engines? Could it even fit up the household part with comfort? We think

that there is no part whatever, from the highest pen-
nant to the keel, that we could trust to the popular
mind, even with all the grandeur with which we are
inclined to believe it to be endowed. There is, prob-
ably, in every department one man only who does
everything best; and, moreover, there is another man
who has a better idea of improvements than any
other man. In building a ship for a long voyage to
bear costly bales about the world, we surely would de-
sire the best of all these men to do the work.

In an advancing age there are always new points
arising, as there are new undertakings. The whole
world has become one great laboratory for experiments
of various kinds. We desire to communicate with our
countrymen more rapidly than by post. Popular science
fails, but investigation obtains a method. This method
soon becomes popular, and thousands of men know it
quite well. We desire, however, to communicate with
America; popular science fails, and investigation again
comes, and Sir W. Thomson makes his sensitive shi-
ning needles.

Popular science is of no value in such cases; it stands
aghast for a little, but it soon seems to know all about it.
Popular science has, perhaps, better than real science,
appreciated the practical value of that which it has
adopted, but it is little able to guide civilisation rushing
onwards into an unknown future, so we must be ex-
tremely careful not to allow the reins to get into her
hands. In such a rapid express train as ours it is need-
ful that there should be men carefully to examine every
inch of the line, and that drivers, stokers, and guards
should be multiplied rather than diminished. They must
work, and their work may be very small in quantity
if only compensation be made by its intrinsic excellence.

ON THE VOLUMETRIC ESTIMATION OF COMMERCIAL IODINE.

BY M. ADOLPHE BOBIERRE,

DIRECTOR OF THE ÉCOLE SUPÉRIEURE DES SCIENCES AT NANTES.

IN the month of May last a manufacturer consulted
me concerning expeditious methods of estimating
iodine. Those generally adopted, and consisting of
the employment of sulphurous acid or hyposulphite of
soda, yield excellent results in clever and experienced
hands, but the normal liquids, whose use is necessary,
vary under the influence of atmospheric oxygen. The
cause of these variations has been studied by Bunsen,
who further demonstrates that the estimation of iodine
by sulphurous acid and starch is possible with dilute
liquids only; because if, on the one hand, the water,
sulphurous acid, and iodine may in certain cases furnish
sulphuric and iodhydric acids—on the other hand, and
in more concentrated liquids, the sulphuric and iodi-
hydric acids will yield iodine and sulphurous acid.

The rapid change in the standard of sulphurous acid,
the necessity of working only upon liquids of a fixed
degree of concentration, and the minute precautions to
be taken in order to obviate these inconveniences, made
me determine, in the first instance, on rejecting this
method, which, although suitable for a laboratory, may
be advantageously supplanted by other processes in a
manufactory. Among the ingenious methods for esti-
mating iodine described by Streng, there is one in
which protochloride of tin is employed as a reducing
agent—this I do not recommend on account of the easy
alteration of the reagent; but Mohr's method, based
upon the use of arsenite of soda with excess of alkali,

appeared so advantageous, as regarded certainty and
rapidity, that I immediately began to consider how to
render its execution as simple as possible. Mohr ad-
vises that the iodine to be estimated should be pounded
in a normal solution of arsenite of soda, adding a small
quantity of starch; when the whole of the iodine is
combined, the liquid will be colourless, and if a normal so-
lution of iodine be then added, the desired standard
will be obtained by a relation previously established be-
tween the arsenious liquid and the iodic solution. In
the hands of an experienced chemist this method is per-
fect, but it necessitates the use of starch, whose trans-
formation into blue iodide is not so instantaneous as to
preclude the possibility of many errors being committed
by a manufacturer.

I succeeded in rapidly effecting the direct estimation
of iodine in the following manner:—

I substituted for the starch reaction the intense red
colour yielded by the action of free iodine upon benzene,
and which was pointed out by M. Moride in 1852.

Numerous comparative experiments made by means
of benzene and chloroform have clearly proved to me
that the first of these liquids, from its feeble density,
and the colour iodine communicates to it, is very pre-
ferable to the other.

Arsenite of soda, rendered strongly alkaline by a
solution of bicarbonate of soda, receives an addition of
benzene. If into this is then poured a solution of
iodide of potassium containing definite quantities of
iodine, it will be seen that, if these quantities vary in
the following proportions—1 to $\frac{1}{2}$, 1 to $\frac{1}{3}$, 1 to $\frac{1}{4}$, 1 to
 $\frac{1}{5}$ —there must have been used, in order to impart a
red colour to the benzene, the following divisions of
iodic solution:—7°50', 15°75', 23°45', 32°50', 40°20';
quantities which are sensibly between those of 8 to 16,
to 24, to 32, to 40 (1). This experiment takes only a
short time, and yields, in addition to the roseate tinge
of the benzene, another significant characteristic—viz.,
the slightly yellowish shade of the aqueous liquid.
Here is the method of operation:—

Preparation of the Reagents.—Make a concentrated
solution of iodide of potassium, which should remain
unchanged for a certain series of experiments: this is
to receive the iodine which is to be tested (2). The
normal liquid arsenite of soda is obtained by combin-
ing 4.95 grs. of arsenious acid with 14.5 grs. of crystal-
lised carbonate of soda, and diluting the aqueous liquid
to one litre. This solution will decolourise an iodised
liquid containing 12.688 grs. of iodine per litre; ad-
mitting that the arsenious liquid may not have this reduc-
ing power, the test will be none the less exact, as
at the moment of effecting it the relation of a given
weight of pure iodine to the arsenite will be deter-
mined.

A somewhat concentrated solution of bicarbonate
of soda must now be prepared, to be used as will be
shown.

Performance of the Analysis.—The analysis is best
effected in a small stoppered flask, such as is generally
used for hydrometric tests. Into this are put 10 c.c.
of arsenite of soda, to which must be added 5 c.c. of
alkaline bicarbonate solution; the whole then receives
a further addition of about 4 c.c. of perfectly colourless
benzene.

A given quantity of pure iodine is weighed between
two watch glasses; dissolve this in the concentrated
solution of iodide of potassium prepared beforehand,
and which must be the same to be used for all the
various estimations which may be made; fill with

this coloured liquid a phial containing 100 c.c., shake it, and pour the contents into a graduated burette.

On allowing the iodised solution to fall into the arsenite drop by drop, and stirring it quickly, the brown colour will be seen to disappear instantaneously; but scarcely will the arsenite have been transformed when traces of free iodine will produce a double phenomenon; in the first place the benzine will turn red; secondly, the aqueous liquid, which was perfectly colourless at the beginning of the operation, assumes a very sensible yellowish tinge; the significant character of this is the more surprising when one comes to compute the very small quantity of metalloid which causes it. It will now be easily understood that a second experiment made upon the iodine to be estimated, the same weight being used, will instantly show the desired strength, since the volume of solution requisite to destroy the alkaline arsenite is in inverse proportion to the quantity of real iodine to be determined.

Finally this method is simple, quick, and based upon known reactions, whose sensibility has been already proved by experience; it is therefore eminently adapted for the use of manufacturers in the estimation of commercial iodine more or less pure.—*Moniteur Scientifique*.

NOTES ON THE FOREGOING.

(1). I ought to state that it has already been proposed to substitute for the use of starch in volumetric experiments the colouring or discolouring of sulphide of carbon and of iodised chloroform (*Dupré, Annales de Chimie et de Pharmacie*, t. xciv., p. 365). M. Dupré's method, however, in no way resembles mine; it is extremely sensitive, but necessitates the employment of a solution of chlorine, while, on the other hand, the indication of the end of the operation is a discolouration. Lastly, the *Journal de Médecine de l'Ouest* of the 31st of August, 1868, contains a notice of a process by M. Bertin, which consists in dissolving the iodine to be estimated in benzine, and adding arsenite of soda until decolourisation ensues. One great advantage, in my opinion, of the process by colouring, is that the most delicate shades are perceptible, and that the tint obtained, more or less clear, will reveal the presence of sulphur in the iodine.

(2). I should have enquired whether an alcoholic solution might not be substituted for that effected by means of iodide of potassium, but I found it necessary to relinquish such a substitution. In this case part of the free iodine remains in the alcohol, which it renders yellow, to the detriment of the colouring of the benzine. This may be ascertained by adding to the alcohol a small quantity of benzine coloured red by iodine: the red colour will immediately diminish until the alcohol assumes a settled tinge of yellow.

SPECTRUM OBSERVATIONS ON THE SUN.

THE Rev. Father Secchi has forwarded the following communication to the French Academy of Sciences:—

"The important discovery of M. Janssen, on the possibility of seeing the luminous rays of the protuberances in full sunshine by means of the spectroscope, induced me to make some researches on this interesting subject; and although a great part of what I have seen may become useless when we hear details from M. Janssen himself, as I may have made some new observations I take the liberty of presenting these results to the Academy.

"The spectroscope that I employed is formed of two excellent prisms of very dispersive heavy flint, and sufficiently perfect not only to double the ray ν sufficiently to enable the distance between its components to be measured, but even to separate the very fine rays which are near β , towards λ . The aperture of the large object glass of Merz was reduced to 8 centimetres, so as to prevent the heat injuring the apparatus; the opening of the slit was as small as possible.

"As soon as the apparatus was directed to the sun, in such a manner that the edge of the solar image fell on the slit, I saw the rays σ and τ reversed—that is to say, luminous in one portion of their length across the spectrum.

"To examine in a more accurate manner the circumstances of these phenomena, I directed the slit alternately parallel and perpendicular to the edge. I then remarked that there was a reversal of the ray σ very near the edge, round the entire disc of the sun; but when the slit was perpendicular, the luminous line was from ten to fifteen seconds at most in length, except in the neighbourhood of the zones of spots and faculae, where it was always four times as long. Many points were observed where this line appeared separated from the edge; these points correspond, doubtless, as M. Janssen has observed, to isolated clouda. If the slit is placed parallel to the tangent of the edge, a brilliant line is seen in all parts which traverses the whole length of the spectrum, and which sometimes divides before arriving at the edge of the sun in this manner: —

on coming nearer the edge the line becomes continuous: —. This observation proves that the rose coloured gaseous envelope is continuous, but very irregular in its outline, as shown by eclipses.

"The ray which appears easiest reversed is the ray σ ; it dominates throughout. The ray τ is also reversed, but always shorter and more feeble, as Mr. Lockyer has remarked. But what has not, I believe, been remarked before is, that near the edge of the sun, even where the ray σ does not become brilliant, the black line disappears and the spectrum becomes uniform. This is not an effect of contrast, but a real phenomenon due to the reversal being only partial. The same thing is observed in the ray τ and many other rays.

"Another curious fact is that the luminous lines become very vivid and brilliant in certain regions. The most remarkable are—A line in the red in contact with the ray β , on the side of σ ; another at a little distance from ν , at about $1\frac{1}{2}$ the width of this ray on the side of the violet; another in the green, between the two wide rays of magnesium; finally, many others among the rays of iron.

"This augmentation of brilliancy does not appear to be due to reversal, for even with a spectroscope of seven prisms I have not seen in any of these regions a black line as large as the corresponding luminous ray. This cannot all be explained by the effect of contrast, although, indeed, this explanation is probable in the case of the green, for there a great number of the fine rays disappear near the edge. Further researches are therefore necessary, and there probably may be another explanation different from that which is usually adopted at present.

"By employing a spectroscope formed of a single very dispersive prism by Merz (with which alone all Kirchhoff's lines may be seen), I have still seen reversed the third line of hydrogen, H γ , in the violet. The black lines undergo a sensible weakening in this region near the edge. It would be premature to ad-

vance a theory, but this partial reversal may easily explain the phenomenon observed by M. Rziha, the astronomer of the Austrian Expedition, who saw that the corona gave a continuous spectrum without lines during the eclipse (*V. Astr. nach*, No. 1716).

"It may be interesting to remark that among the luminous lines observed by us are found rays near to α and β which do not belong to hydrogen, and which were seen luminous by M. Rayet. Doubtless this astronomer, owing to the feeble power of his instrument, could not notice the small space which separates them from Fraunhofer's black line.

"Thus the discovery of M. Janssen enables us to appreciate new facts, which will throw much light on many points which are still doubtful connected with this spectrum theory of the sun."

ON A NEW SERIES OF CHEMICAL REACTIONS PRODUCED BY LIGHT.*

BY JOHN TYNDALL, LL.D., F.R.S., &c.

I ASK permission of the Royal Society to draw the attention of chemists to a form or method of experiment, which, though obvious, is, I am informed, unknown, and which, I doubt not, will in their hands become a new experimental power. It consists in subjecting the vapours of volatile liquids to the action of concentrated sunlight, or to the concentrated beam of the electric light.

Action of the Electric Light.—A glass tube 2·8 feet long and of 2·5 inches internal diameter, frequently employed in my researches on radiant heat, was supported horizontally. At one end of it was placed an electric lamp, the height and position of both being so arranged that the axis of the glass tube and that of the parallel beam issuing from the lamp were coincident. The tube in the first experiment was closed by plates of rock-salt, and subsequently by plates of glass.

As on former occasions, for the sake of distinction, I will call this tube the experimental tube.

The experimental tube was connected with an air-pump, and also with a series of drying and other tubes used for the purification of the air.

A number of test-tubes (I suppose I have used fifty of them in all) were converted into Woulfe's flasks. Each of them was stopped by a cork through which passed two glass tubes: one of these tubes (*a*) ended immediately below the cork, while the other (*b*) descended to the bottom of the flask, being drawn out at its lower end to an orifice about 0·03 of an inch in diameter. It was found necessary to coat the cork carefully with cement.

The little flask thus formed was partially filled with the liquid whose vapour was to be examined; it was then introduced into the path of the purified current of air.

The experimental tube being exhausted, and the cock which cut off the supply of purified air being cautiously turned on, the air entered the flask through the tube *b*, and escaped by the small orifice at the lower end of *b* into the liquid. Through this it bubbled, loading itself with vapour, after which the mixed air and vapour, passing from the flask by the tube *a*, entered the experimental tube, where they were subjected to the action of light.

The power of the electric beam to reveal the exist-

ence of anything within the experimental tube, or the impurities of the tube itself, is extraordinary. When the experiment is made in a darkened room, a tube which in ordinary daylight appears absolutely clean is often shown by the present mode of examination to be exceedingly filthy.

The following are some of the results obtained with this arrangement:—

Nitrite of Amyl (boiling-point 91° to 96° C.).—The vapour of this liquid was in the first instance permitted to enter the experimental tube while the beam from the electric lamp was passing through it. Curious clouds were observed to form near the place of entry, which were afterwards whirled through the tube.

The tube being again exhausted the mixed air and vapour were allowed to enter it in the dark. The slightly convergent beam of the electric light was then sent through the tube from end to end. For a moment the tube was optically empty—nothing whatever was seen within it; but before a second had elapsed a shower of liquid spherules was precipitated on the beam, thus generating a cloud within the tube. This cloud became denser as the light continued to act, showing at some places a vivid iridescence.

The beam of the electric lamp was now converged so as to form within the tube, between its end and the focus, a cone of rays about 8 inches long. The tube was cleansed and again filled in darkness. When the light was sent through it, the precipitation upon the beam was so rapid and intense that the cone, which a moment before was invisible, flashed suddenly forth like a solid luminous spear.

The effect was the same when the air and vapour were allowed to enter the tube in diffuse daylight. The cloud, however, which shone with such extraordinary radiance under the electric beam, was invisible in the ordinary light of the laboratory.

The quantity of mixed air and vapour within the experimental tube could of course be regulated at pleasure. The rapidity of the action diminished with the attenuation of the vapour. When, for example, the mercurial column associated with the experimental tube was depressed only 5 inches, the action was not nearly so rapid as when the tube was full. In such cases, however, it was exceedingly interesting to observe, after some seconds of waiting, a thin streamer of delicate bluish-white cloud slowly forming along the axis of the tube, and finally swelling so as to fill it.

When dry oxygen was employed to carry in the vapour, the effect was the same as that obtained with air.

When dry hydrogen was used as a vehicle, the effect was also the same.

The effect, therefore, is not due to any interaction between the vapour of the nitrite and its vehicle.

This was further demonstrated by the deportment of the vapour itself. When it was permitted to enter the experimental tube unmixed with air or any other gas, the effect was substantially the same. Hence the seat of the observed action is the vapour itself.

With reference to the air and the glass of the experimental tube, the beam employed in these experiments was perfectly cold. It had been sifted by passing it through a solution of alum, and through the thick double-convex lens of the lamp. When the unsifted beam of the lamp was employed, the effect was still the same; the obscure calorific rays did not appear to interfere with the result.

I have taken no means to determine strictly the character of the action here described, nor to

* From the *Proceedings of the Royal Society*, No. 105, 1868.

simply to point out to chemists a method of experiment which reveals a new and beautiful series of reactions; to them I leave the examination of the products of decomposition. The molecule of the nitrite of amyl is shaken asunder by certain specific waves of the electric beam, forming nitric oxide and other products, of which the nitrate of amyl is probably one. The brown fumes of nitrous acid were seen to mingle with the cloud within the experimental tube.

The nitrate of amyl, being less volatile than the nitrite, could not maintain itself in the condition of vapour, but would be precipitated in liquid spherules along the track of the beam.

In the anterior portions of the tube a sifting action of the vapour occurs, which diminishes the chemical action in the posterior portions. In some experiments the precipitated cloud only extended halfway down the tube. When, under these circumstances, the lamp was shifted so as to send the beam through the other end of the tube, precipitation occurred there also.

Action of Sunlight.—The solar light also effects the decomposition of the nitrite-of-amyl vapour. On the 10th of October I partially darkened a small room at the Royal Institution, into which the sun shone, permitting the light to enter through an open portion of the window-shutter. In the track of the beam was placed a large plano-convex lens, which formed a fine convergent cone in the dust of the room behind it. The experimental tube was filled in the laboratory, covered with a black cloth, and carried into the partially darkened room. On thrusting one end of the tube into the cone of rays behind the lens, precipitation within the cone was copious and immediate. The vapour at the distant end of the tube was in part shielded by that in front, and was also more feebly acted on through the divergence of the rays. On reversing the tube, a second and similar cone was precipitated.

Physical Considerations.—I sought to determine the particular portion of the white beam which produced the foregoing effects. When, previous to entering the experimental tube, the beam was caused to pass through a red glass, the effect was greatly weakened, but not extinguished. This was also the case with various samples of yellow glass. A blue glass being introduced, before the removal of the yellow or the red, on taking the latter away, augmented precipitation occurred along the track of the blue beam. Hence, in this case, the more refrangible rays are the most chemically active.

The colour of the liquid nitrite of amyl indicates that this must be the case; it is a feeble but distinct yellow; in other words, the yellow portion of the beam is most freely transmitted. It is not, however, the transmitted portion of any beam which produces chemical action, but the absorbed portion. Blue, as the complementary colour to yellow, is here absorbed, and hence the more energetic action of the blue rays. This reasoning, however, assumes that the same rays are absorbed by the liquid and its vapour.

A solution of the yellow chromate of potash, the colour of which may be made almost, if not altogether, identical with that of the liquid nitrite of amyl, was found far more effective in stopping the chemical rays than either the red or the yellow glass. But of all substances the nitrite itself is most potent in arresting the rays which act upon its vapour. A layer one-eighth of an inch in thickness, which scarcely perceptibly affected the luminous intensity, sufficed to absorb the entire chemical energy of the concentrated beam of the electric light.

The close relation subsisting between a liquid and its vapour, as regards their action upon radiant heat, has been already amply demonstrated.* As regards the nitrite of amyl, this relation is more specific than in the cases hitherto adduced; for here the special constituent of the beam which provokes the decomposition of the vapour is shown to be arrested by the liquid.

A question of extreme importance in molecular physics here arises:—What is the real mechanism of this absorption, and where is its seat?†

I figure, as others do, a molecule as a group of atoms, held together by their mutual forces, but still capable of motion among themselves. The vapour of the nitrite of amyl is to be regarded as an assemblage of such molecules. The question now before us is this:—In the act of absorption, is it the molecules that are effective, or is it their constituent atoms? Is the *vis viva* of the intercepted waves transferred to the molecule as a whole, or to its constituent parts?

The molecule, as a whole, can only vibrate in virtue of the forces exerted between it and its neighbour molecules. The intensity of these forces, and consequently the rate of vibration, would, in this case, be a function of the distance between the molecules. Now the identical absorption of the liquid and of the vaporous nitrite of amyl indicates an identical vibrating period on the part of liquid and vapour, and this, to my mind, amounts to an experimental demonstration that the absorption occurs in the main within the molecule. For it can hardly be supposed, if the absorption were the act of the molecule as a whole, that it could continue to affect waves of the same period after the substance had passed from the vaporous to the liquid state.

In point of fact, the decomposition of the nitrite of amyl is itself to some extent an illustration of this internal molecular absorption; for were the absorption the act of the molecule as a whole, the relative motions of its constituent atoms would remain unchanged, and there would be no mechanical cause for their separation. It is probably the synchronism of the vibrations of one portion of the molecule with the incident waves which enables the amplitude of those vibrations to augment until the chain which binds the parts of the molecule together is snapped asunder.

The liquid nitrite of amyl is probably also decomposed by light; but the reaction, if it exists, is incomparably less rapid and distinct than that of the vapour. Nitrite of amyl has been subjected to the concentrated solar rays until it boiled, and it has been permitted to continue boiling for a considerable time, without any distinctly apparent change occurring in the liquid.‡

I anticipate wide, if not entire, generality for the fact that a liquid and its vapour absorb the same rays. A cell of liquid chlorine now preparing for me will, I imagine, deprive light more effectually of its power of causing chlorine and hydrogen to combine than any other filter of the luminous rays. The rays which give chlorine its colour have nothing to do with this combination, those that are absorbed by the chloride being the really effective rays. A highly sensitive bulb, containing chlorine and hydrogen in the exact proportions necessary for the formation of hydrochloric acid, was placed at one end of the experimental tube, the beam of the electric lamp being sent through it from the other.

* *Phil. Trans.*, 1864.

† My attention was very forcibly directed to this subject some years ago by a conversation with my excellent friend Professor Clausius.

‡ On the 21st of October, Mr. Ernest Chapman mentioned to me in conversation that he once exposed nitrite-of-amyl vapour to the action of light. With what result I do not know.

The bulb did not explode when the tube was filled with chlorine, while the explosion was violent and immediate when the tube was filled with air. I anticipate for the liquid chlorine an action similar to, but still more energetic than, that exhibited by the gas. If this should prove to be the case, it will favour the view that chlorine itself is molecular and not monatomic. Other cases of this kind I hope, at no distant day, to bring before the Royal Society.

Production of Sky-blue by the decomposition of Nitrite of Amyl.—When the quantity of nitrite vapour is considerable, and the light intense, the chemical action is exceedingly rapid, the particles precipitated being so large as to whiten the luminous beam. Not so, however, when a well-mixed and highly-attenuated vapour fills the experimental tube. The effect now to be described was obtained in the greatest perfection when the vapour of the nitrite was derived from a residue of the moisture of its liquid, which had been accidentally introduced into the passage through which the dry air flowed into the experimental tube.

In this case the electric beam traversed the tube for several seconds before any action was visible. Decomposition then visibly commenced, and advanced slowly. The particles first precipitated were too small to be distinguished by an eye-glass; and, when the light was very strong, the cloud appeared of a milky blue. When, on the contrary, the intensity was moderate, the blue was pure and deep. In Brücke's important experiments on the blue of the sky and the morning and evening red, pure mastic is dissolved in alcohol, and then dropped into water well stirred. When the proportion of mastic to alcohol is correct, the resin is precipitated so finely as to elude the highest microscopic power. By reflected light, such a medium appears bluish, by transmitted light yellowish, which latter colour, by augmenting the quantity of the precipitate, can be caused to pass into orange or red.

But the development of colour in the attenuated nitrite-of-amyl vapour, though admitting of the same explanation, is, doubtless, more similar to what takes place in our atmosphere. The blue, moreover, is purer and more sky-like than that obtained from Brücke's turbid medium. There could scarcely be a more impressive illustration of Newton's mode of regarding the generation of the colour of the firmament than that here exhibited; for never, even in the skies of the Alps, have I seen a richer or a purer blue than that attainable by a suitable disposition of the light falling upon the precipitated vapour. May not the aqueous vapour of our atmosphere act in a similar manner? and may we not fairly refer to liquid particles of infinitesimal size the hues observed by Principal Forbes over the safety-valve of a locomotive, and so skilfully connected by him with the colours of the sky?

In exhausting the tube containing the mixed air and nitrite-of-amyl vapour, it was difficult to avoid explosions under the pistons of the air-pump similar to those which I have already described as occurring with the vapours of bisulphide of carbon and other substances. Though the quantity of vapour present in these cases must have been infinitesimal, its explosion was sufficient to destroy the valves of the pump.

Iodide of Allyl (boiling point 101° C.).—Among the liquids hitherto subjected to the concentrated electric light, iodide of allyl, in point of rapidity and intensity of action, comes next to the nitrite of amyl. With the iodide of allyl I have employed both oxygen and hydrogen, as well as air, as a vehicle, and found the effect in

all cases substantially the same. The cloud column here was exquisitely beautiful, but its forms were different from those of the nitrite of amyl. The whole column revolved round the axis of the decomposing beam; it was nipped at certain places like an hour-glass, and round the two bells of the glass delicate cloud-filaments twisted themselves in spirals. It also folded itself into convolutions resembling those of shells. In certain conditions of the atmosphere in the Alps I have often observed clouds of a special pearly lustre; when hydrogen was made the vehicle of the iodide-of-allyl vapour, a similar lustre was most exquisitely shown. With a suitable disposition of the light, the purple hue of iodine vapour came out very strongly in the tube.

The remark already made, as to the bearing of the decomposition of nitrite of amyl by light on the question of molecular absorption, applies here also; for were the absorption the work of the molecule as a whole, the iodine would not be dislodged from the allyl with which it is combined. The non-synchronism of iodine with the waves of obscure heat is illustrated by its marvellous transparency to such heat. May not its synchronism with the waves of light in the present instance be the cause of its divorce from the allyl? Further experiments on this point are in preparation.

Iodide of Isopropyl.—The action of light upon the vapour of this liquid is at first more languid than upon iodide of allyl; indeed many beautiful reactions may be overlooked in consequence of this languor at the commencement. After some minutes' exposure, however, clouds begin to form, which grow in density and in beauty as the light continues to act. In every experiment hitherto made with this substance the column of cloud which filled the experimental tube was divided into two distinct parts near the middle of the tube. In one experiment, a globe of cloud formed at the centre, from which, right and left, issued an axis which united the globe with the two adjacent cylinders. Both globe and cylinders were animated by a common motion of rotation. As the action continued, paroxysms of motion were manifested; the various parts of the cloud would rush through each other with sudden violence. During these motions beautiful and grotesque cloud-forms were developed. At some places the nebulous mass would become ribbed so as to resemble the graining of wood; a longitudinal motion would at times generate in it a series of curved transverse bands, the retarding influence of the sides of the tube causing an appearance resembling, on a small scale, the dirt-bands of the Mer de Glace. In the anterior portion of the tube those sudden commotions were most intense; here buds of clouds would sprout forth, and grew in a few seconds into perfect flower-like forms. The most curious appearance that I noticed was that of a cloud resembling a serpent's head: it grew rapidly; a mouth was formed, and from the mouth a cord of cloud resembling a tongue was rapidly discharged. The cloud of iodide of isopropyl had a character of its own, and differed materially from all others that I had seen. A gorgeous mauve colour was developed in the last twelve inches of the tube; the vapour of iodine was present, and it may have been the sky-blue produced by the precipitated particles which, mingling with the purple of the iodine, produced this splendid mauve. As in all other cases here adduced, the effects were proved to be due to the light; they never occurred in darkness.

I should like to guard myself against saying more than the facts warrant regarding the chemical effects produced by light in the following three-substances; but the phy-

sical appearances are so exceedingly singular that I do not hesitate to describe them.

Hydrobromic Acid.—The aqueous solution of this acid was placed in a small Woulfe's flask, and carried into the experimental tube by a current of air.

The tube being filled with the mixture of acid, aqueous vapour, and air, the beam was sent through it, the lens at the same time being so placed as to produce a cone of very intense light. Two minutes elapsed before anything was visible; but at the end of this time a faint bluish cloud appeared to hang itself on the most concentrated portion of the beam.

Soon afterwards a second cloud was formed five inches further down the experimental tube. Both clouds were united by a slender cord of cloud of the same bluish tint as themselves.

As the action of the light continued, the first cloud gradually resolved itself into a series of parallel discs of exquisite delicacy; the discs rotated round an axis perpendicular to their surfaces, and finally they blended together to produce a screw surface with an inclined generatrix. This surface gradually changed into a filmy funnel, from the end of which the "cord" extended to the cloud in advance. This also underwent modification. It resolved itself into a series of strata resembling those of the electric discharge. After a little time, and through changes which it was difficult to follow, both clouds presented the appearance of a series of concentric funnels set one within the other, the interior ones being seen through the spectral walls of the outer ones; those of the distant cloud resembled claret glasses in shape. As many as six funnels were thus concentrically set together, the two series being united by the delicate cord of cloud already referred to. Other cords and slender tubes were afterwards formed, and they coiled themselves in spirals around and along the funnels.

Rendering the light along the connecting cord more intense, it diminished in thickness and became whiter; this was a consequence of the enlargement of its particles. The cord finally disappeared, while the funnels melted into two ghost-like films, shaped like parasols. The films were barely visible, being of an exceedingly delicate blue tint; they seemed woven of blue air. To compare them with cobweb or with gauze would be to liken them to something infinitely grosser than themselves.

In a second trial the result was very much the same. A cloud which soon assumed the parasol shape was formed in front, and 5 inches lower down another cloud was formed, in which the funnels already referred to were considerably sharpened. It was connected as before by a filament with the cloud in front, and it ended in a spear-point which extended 12 inches further down the tube.

After many changes, the film in front assumed the shape of a bell, to the convex surface of which a hollow cylinder about 2 inches long attached itself. After some time this cylinder broke away from the bell and formed itself into an iridescent ring, which, without apparent connection with anything else, rotated on its axis in the middle of the tube. The inner diameter of this ring was nearly an inch in length, and its outer diameter nearly an inch and a half.

The whole cloud composed of these heterogeneous parts was animated throughout by a motion of rotation. The rapidity of the rotation could be augmented by intensifying the beam. The disks, funnels, strata, and convolutions of the cloud exhibited at times diffraction colours, which changed colour with every motion of the observer's eye.

Moisture appeared to be favourable to the production of these appearances; and it hence became a question how far they were really produced by the light: hydrobromic acid, even from its solution, fumes when it comes into contact with the aqueous vapour of the air; its residence in water does not appear to satisfy its appetite for the liquid. The same effect, as everybody knows, is observed in the solution of hydrochloric acid. Might not, then, those wonderfully-shaped clouds be produced by an action of this kind, the presence of the light being an unnecessary accident?

The hydrobromic acid was permitted to enter the experimental tube and remain in diffuse daylight for five minutes. On darkening the room and sending the electric beam through it, the tube was optically empty. Two minutes' action of the light caused the clouds to appear, and they afterwards went through the same variety of changes as before.

No matter how long the hydrobromic acid was allowed to remain in the tube, no action occurred until the luminous beam was brought into play. The tube filled with the mixture of air, aqueous vapour, and hydrobromic acid, was permitted to remain for fifteen minutes in the dark. On sending the beam through the tube, it was found optically empty; but two minutes' action of the light developed the clouds as before.

Permitting the beam to pass through a layer of water before entering the experimental tube, no diminution of its chemical energy was observed. Permitting it to pass through a solution of hydrobromic acid, of the same thickness, the chemical energy of the beam was wholly destroyed. This shows that the vibrations of the dissolved acid are synchronous with those of the gaseous acid, and is a new proof that the constituent atoms of the molecule, and not the molecule itself, is the seat of the absorption.

Hydrochloric Acid.—The aqueous solution of this acid was also employed and treated like the solution of hydrobromic acid. I intend to invoke the aid of an artistic friend in an effort to reproduce the effects observed during the decomposition, if such it be, of hydrochloric acid by light. But artistic skill must, I fear, fail to convey a notion of them. The cloud was of slow growth, requiring fifteen or twenty minutes for its full development. It was then divided into four or five sections, every adjacent two of which were united by a slender axial cord. Each of these sections possessed an exceedingly complex and ornate structure, exhibiting ribs, spears, funnels, leaves, involved scrolls, and iridescent *fleurs-de-lis*. Still the structure of the cloud from beginning to end was perfectly symmetrical; it was a cloud of revolution, its corresponding points being at equal distances from the axis of the beam. There are many points of resemblance between the clouds of hydrochloric and hydrobromic acid, and both are perfectly distinct from anything obtainable from the substances previously mentioned; in fact, every liquid appears to have its own special cloud, varying only within narrow limits from a normal type. The formation of the cloud depends rather upon its own inherent forces than upon the environment. It is true that, by warming or chilling the experimental tube at certain points, extraordinary flexures and whirlwinds may be produced; but with a perfectly constant condition of tube, specific differences of cloud-structure are revealed, the peculiarity of each substance stamping itself apparently upon the precipitated vapour derived from its decomposition.

When the beam before entering the experimental tube was sent through a layer of the aqueous acid,

thirteen minutes' exposure produced no action. A layer of water being substituted for the layer of acid, one minute's exposure sufficed to set up the decomposition.

Hydriodic Acid.—The aqueous solution of this acid was also employed. On first subjecting it to the action of light no visible effect was produced; but subsequent trials developed a very extraordinary one. A family resemblance pervades the nebulae of hydriodic, hydrobromic, and hydrochloric acids. In all three cases, for example, the action commenced by the formation of two small clouds united by a cord; it was very slow, and the growth of the cloud in density and beauty very gradual. The most vivid green and crimson that I have yet observed were exhibited by this substance in the earlier stages of the action. The development of the cloud was like that of an organism, from a more or less formless mass at the commencement, to a structure of marvellous complexity. I have seen nothing so astonishing as the effect obtained, on the 28th of October, with hydriodic acid. The cloud extended for about 18 inches along the tube, and gradually shifted its position from the end nearest the lamp to the most distant end. The portion quitted by the cloud proper was filled by an amorphous haze, the decomposition which was progressing lower down being here apparently complete. A spectral cone turned its apex towards the distant end of the tube, and from its circular base filmy drapery seemed to fall. Placed on the base of the cone was an exquisite vase, from the interior of which sprang another vase of similar shape; over the edges of these vases fell the faintest clouds, resembling spectral sheets of liquid. From the centre of the upper vase a straight cord of cloud passed for some distance along the axis of the experimental tube, and at each side of this cord two inviolent and highly iridescent vortices were generated. The frontal portion of the cloud, which the cord penetrated, assumed in succession the forms of roses, tulips, and sunflowers. It also passed through the appearance of a series of beautifully-shaped bottles placed one within the other. Once it presented the shape of a fish, with eyes, gills, and feelers. The light was suspended for several minutes, and the tube and its cloud permitted to remain undisturbed in darkness. On re-igniting the lamp, the cloud was seen apparently motionless within the tube; much of its colour had gone, but its beauty of form was unimpaired. Many of its parts were calculated to remind one of Gassiot's discharges; but in complexity, and, indeed, in beauty, the discharges would not bear comparison with these arrangements of cloud. A friend to whom I showed the cloud likened it to one of those jelly-like marine organisms which a film barely capable of reflecting the light renders visible. Indeed no other comparison is so suitable; and not only did the perfect symmetry of the exterior suggest this idea, but the exquisite casing and folding of film within film suggested the internal economy of a highly complex organism. The twoness of the animal form was displayed throughout, and no coil, disc, or speck existed on one side of the axis of the tube that had not its exact counterpart at an equal distance on the other. I looked in wonder at this extraordinary production for nearly two hours.*

* "It is as perfect as if turned in a lathe;" "It would prove exceedingly valuable to pattern-designers," were remarks made by my assistants as they watched the experiment. Mr. Ludd, who is intimately acquainted with the phenomena of the electric discharge through rarefied media, remarked that no effect he had ever seen could compete in point of beauty and complexity with the appearance

The precise conditions necessary to render the production of the effects observed with hydrobromic, hydrochloric, and hydriodic acids a certainty have not yet been determined. Air, moreover, is the only vehicle which has been employed here. I hazard no opinion as to the chemical nature of these reactions. The dry acids, moreover, I have not yet examined.

ON THE COMPOSITION AND METALLURGY OF SOME NORWEGIAN TITANIFEROUS IRON ORES.

BY DAVID FORBES, F.R.S., ETC.

CONSIDERABLE attention has of late been directed to the utilisation of the titaniferous iron ores, which are found abundantly in New Zealand, Canada, Scandinavia, and other countries, under the supposition, entertained by many engaged in the manufacture of iron, that these ores yield, on smelting, an iron or steel alloyed with titanium and of very superior quality.

In the numerous articles and discussions which have appeared in English journals upon this topic the subject has been treated as one of entire novelty, and various patents have also been taken out, evidently under the impression that such ores had never previously been utilised, and that their treatment, as well as the nature of their products, had been previously quite unknown to metallurgists.

So far, however, from this being in reality the case, it is well known that the titaniferous magnetites of Sweden, Finland, and Norway, have, from very old periods, been mined and smelted on the large scale in the charcoal blast furnaces of those countries, where their metallurgic treatment and value are thoroughly understood and appreciated; and several Scandinavian iron-masters have expressed to me their surprise at the want of information possessed by English metallurgists in general upon this subject.

My own experience in the smelting of titaniferous iron ores dates from as far back as 1847, when I acted as consul to some small charcoal iron works in the south of Norway, where such ores were smelted in quantity. From my notes and analyses I have extracted the following remarks, which may be regarded as a continuation of a short paper "On the Composition and Metallurgy of some Norwegian Iron Ores," which appeared in No. 416 of this journal (Nov. 22, 1867, *Am. Repr.*, Jan. 1868, p. 24), and which may not be without interest to metallurgists.

Titaniferous Magnetite (Cristine Mine, Krageroe).—This ore occurs as a lode, or more properly, metalliferous zone, imbedded in the metamorphic schists in the small islands, or rather rocks, called Dybsunds Holmene, in the Krageroe fjord, in Southern Norway. The ore in this zone is about 6 feet wide, but generally occurs in lenticular masses, having a general strike of N.N.W., with a dip of 80° westerly. The metallic deposit is cut across by a posterior granite dyke, which, however, does not materially disturb its course. The ore itself is titaniferous magnetite; it is attracted by the magnet, but not very strongly so, and is intermixed with particles of colourless quartz and green-black hornblende, whilst it is occasionally seen to contain minute spangles of magnetic pyrites. Its colour is brilliant black, and it retains this colour and lustre even after long exposure to the air and moisture.

here imperfectly described. I mention this to indicate how the phenomena affected other eyes than mine.

The analysis of this ore was conducted as follows:—A weighed amount of the ore was fused in a gold crucible with eight times its weight of bisulphate of soda, until all soluble matter had been taken up. The fused mass was treated with cold water until nothing remained but some pure white silica, which was filtered off, washed, and determined; to the solution, much diluted with water, a few drops of nitric acid was added (in order to prevent the titanitic acid carrying down sesquioxide of iron along with it), and the whole boiled for a considerable period. The titanitic acid thus precipitated was determined after ignition, when it possessed a light yellow colour. The alumina, oxide of iron, lime, and magnesia in the filtrate were now separated as usual, and the determination of the iron checked by the volumetric process (by bichromate of potash) upon a separate portion of the ore dissolved in nitro-hydrochloric acid, and also used for determining the amount of sulphur present. Phosphorus was sought for, but not discovered, although both Abel's and Spiller's methods (*CHEMICAL NEWS*, vol. vi, p. 133, and vol. xiii, p. 170 *Eng. Ed.*), as well as the molybdate process, were employed. The following percentage results were obtained:—

Iron	42.04
Oxygen (as loss).....	16.03
Protoxide of manganese	0.14
Alumina	2.61
Lime	2.11
Magnesia	1.88
Silica	19.90
Titanic acid.....	15.10
Sulphur	0.19
Phosphorus	0.00

100.00

The experience of the Scandinavian iron-masters has shown that the only objection to the use of titaniferous ores is, that they are found to be more and more refractory in the blast furnace in proportion as they contain a greater percentage of titanitic acid; and if much titanium is present, they require so much larger an amount of charcoal to smelt them as not to render their employment profitable in a country where other ores free from titanium can be obtained at a reasonable rate.

After considerable experience in smelting the above ore, which yielded a very good iron, it was found unprofitable to smelt it alone for the above reason; but its use was found beneficial when employed in about equal proportions with the other ores of the district which were free from titanium. In the attempts to cause it to smelt more easily, my predecessor, under the supposition that a volatile compound of silicon and titanium would be formed, fluxed this ore with gradually increasing charges of stamped quartz, until at last a cast-iron was obtained so highly charged with silicon that it flowed from the furnace like porridge.

I, on the contrary, used lime as a flux, and probably went at first to the other extreme, with the object of slagging off the titanitic acid as titanate of lime, but I did not obtain a satisfactory result; subsequently, however, the examination of some silico-titanates, which proved much more fusible than pure titanates, led me to employ a mixture of stamped quartz and limestone as a flux. This was found to give very satisfactory results in practice, and when the amount of titanium in the ore did not exceed 8 per cent, or was reduced to this percentage by admixture of other ores of iron free

from titanitic acid, no difficulty was experienced in working this ore cleanly and profitably. The cast-iron produced, upon analysis, did not contain phosphorus, only a trace of sulphur, and afforded 0.05 per cent titanitic acid, equal to 0.03 per cent titanium, which I imagine was rather mechanically intermixed than chemically combined with the iron.

The cast-iron, however, possessed a peculiar fracture, not easily described, but easily distinguished by the furnace men, who could at once recognise the pig from these ores, even after it had been re-melted in the cupola.

The slags from this ore (and titaniferous ores in general), even in cases where it had only been employed as an admixture of as low as 10 per cent of the charge, are at once recognisable, both by their behaviour when fluid, as well as their appearance and fracture when cold. As they flow from the furnace, a series of blisters (if they may be so called) rise up from the slag, sometimes to the height of from 6 inches to a foot, and about the thickness of the wrist; after standing up thus for some minutes with a very peculiar appearance, they suddenly collapse, and sink into the still fluid current of slag, leaving merely a depressed mark to show where they had previously raised themselves.

When cold the slag has generally an external glassy coating, about $\frac{1}{4}$ th to $\frac{1}{2}$ of an inch in thickness, of a greenish or greenish brown colour, beneath which the whole mass is an agglomeration of crystalline needles, of a brown or brownish yellow colour, often very porous.

Many of these slags are tinged blue, especially when more compact, and they have often a fine blue colour at the points of junction of the crystalline internal mass with the external vitreous coating, this colour being probably due to the reduction of the titanitic acid to a lower state of oxidation.

The blast furnace in which these ores were smelted possessed the following dimensions:—Total vertical height from sole of hearth to charging plane, 32 feet; height from hearth to tuyeres, $1\frac{1}{2}$ feet; ditto to shoulder, 6 feet; ditto from shoulder to widest diameter, 2 feet; diameter at hearth, 2 feet; ditto at shoulder, 4 feet; ditto at widest part, 7 feet; ditto at charging plane, 5 feet. The blast was provided by three square boxes, and was heated to about 500° F. (260° C.) by the waste gases from the furnace. The ore was roasted in furnaces situated on the top of the furnace and heated by the waste gases, and after roasting it was broken up to the size of nutmegs by rollers. The charcoal employed was a mixture of spruce, fir, and pine, and it required 40 English cubic feet of this charcoal (about 3744 lbs. in weight) to produce 1 ton cast-iron. The total yield of cast-iron per week from these small furnaces was, on an average, about 16 tons, the ore producing about 33 per cent iron.

Titaniferous Magnetite (Gullaxrud Mine, Eger).—The occurrence of this ore is very strikingly similar to that of the last described, and it may be stated that the majority of the titaniferous iron deposits of Scandinavia which I have examined possess characters of great similarity with one another, seldom or ever being found as true metallic lodes, but usually as deposits in the metamorphic schists (generally hornblende) in lenticular masses, which arrange themselves in the direction of the foliation of the rock itself.

In the Gullaxrud mine the long axis of the lenticular mass of iron ore runs about east and west, the deposit dipping at a high angle (80°) to the north; and at the

point upon which the main workings have been sunk the clean ore possessed a width of about 18 feet.

The mineral is a titaniferous magnetite of a brilliant deep black colour, which does not change or rust upon exposure to air and moisture; it contains a somewhat intimate admixture of hornblende and quartz with specks of magnetic sulphide of iron, and the whole is slightly attracted by the magnet.

The analysis was conducted in the same manner as in the case of the previously-described titaniferous magnetite from Krageroe, with the exception only that the phosphorus present was separated by fusion with carbonate of soda, and afterwards determined as pyrophosphate of magnesia in the usual manner. The results obtained were as follows:—

Iron	38.89
Oxygen (as loss)	14.84
Protoxide of manganese	0.48
Alumina	1.70
Lime	3.55
Magnesia	3.98
Silica	28.10
Titanic acid	7.10
Sulphur	0.59
Phosphorus	0.77

100.00

The amounts of phosphorus and sulphur contained in this ore are so large as to prevent its being employed for the production of charcoal bar-iron, as the trial smeltings made for this purpose showed that the bars obtained were extremely red-short. The abundance of the ore, and its consequent cheapness, as well as its proximity to the smelting works, rendered it, however, of importance for the production of casting pig. A sample of this pig was examined by me, and found to contain both sulphur and phosphorus, along with 0.26 per cent titanic acid, equivalent to 0.16 per cent metallic titanium, which most probably was only mechanically intermixed, and not alloyed or chemically combined with the iron.

The ore when smelted alone was found to be refractory, and not to produce a liquid slag; but this difficulty disappeared when it was smelted along with other ores free from titanium, in a similar manner to the titaniferous magnetite from Krageroe before described.

THE ZIRCONIA LIGHT.

Messrs. Tessié du Motay and Co. have patented an invention for improvements in preparing zirconia, and the employment of the same to develop the light of oxyhydrogen flame. The specification is as follows:—

Zirconia, or oxide of zirconium, in whatever manner it may be extracted from its ores, can be agglomerated by compression; for example, into sticks, discs, cylinders, or other forms suitable for being exposed to the flame of mixtures of oxygen and hydrogen, without undergoing fusion or other alteration. Of all the known terrous oxides it is the only one which remains entirely unaltered when submitted to the action of a blowpipe fed by oxygen and hydrogen, or mixtures of oxygen with gaseous or liquid carbonated hydrogens. Zirconia is also, of all the terrous oxides, that which, when introduced into an oxyhydrogen flame, develops the most intense and the most fixed light.

To obtain zirconia in a commercial state I extract it

from its native ores by transforming by the action of chlorine in the presence of coal or charcoal the silicate of zirconium into double chloride of zirconium and of silicon. The chloride of silicon, which is more volatile than the chloride of zirconium, is separated from the latter by the action of heat; the chloride of zirconium remaining is afterwards converted to the state of oxide by any of the methods now used in chemistry. The zirconia thus obtained is first calcined, then moistened, and submitted in moulds to the action of a press with or without the intervention of agglutinant substances, such as borax, boracic acid, or clay. The sticks, cylinders, discs, or other forms thus agglomerated, are brought to a high temperature, and thus receive a kind of tempering or preparing, the effect of which is to increase their density and molecular compactness.

I can also compress in moulds shaped for the purpose a small quantity of zirconium capable of forming a cylinder or piece of little thickness, which may be united by compression in the same mould to other refractory earths, such as magnesia and clay. In this manner I obtain sticks or pieces of which only the part exposed to the action of the flame is of pure zirconia, while the remaining portion which serves as a support to it is composed of a cheap material.

The property composed by zirconia of being at once the most infusible, the most unalterable, and the most luminous of all the chemical substances at present known when it is exposed to the action of an oxyhydrogen flame, has never before been discovered, nor has its property of being capable of agglomeration and moulding, either separately or mixed with a small portion of an agglutinant substance.

ON FOOD.*

BY DR. LETHEBY, M.A., M.B., &c.

(Continued from *Am. Repr.*, January, 1869, page 19.)

Preservation of Food—Unwholesome and Adulterated Food.

It requires no argument to show that the preservation of food is a matter of great public importance; for it not only enables us to provide against actual want in periods of unusual scarcity, but it also affords the means of equalising the distribution of food at all times, so that the excess of one country may be used in supplying the deficiency of another. In the pastoral districts—for example, of Canada, Australia, Tasmania, the Cape of Good Hope, Mexico, the Argentine Republic, and the Brazils—thousands of tons of meat are always available as food, and yet they are lost to us because of the difficulties of preserving it. In South America, at least 2,000,000 beasts are annually slaughtered for the fat, skin, and bones, the flesh of which could be supplied here at less than 2½d. per lb. So also in Australia, the amount of meat available as food is practically inexhaustible. Last year Mr. Philpott stated to the Food Committee of the Society of Arts, that he himself was in the habit of melting down from 1,000 to 1,500 sheep daily for four months together; and that in the vast districts of rich pasture-land from Victoria to Brisbane, there was an unlimited supply of the very finest meat—all of which was at present entirely wasted, because of the difficulty of disposing of the flesh; and therefore the carcasses of the animals were melted down for fat. A bullock in

* The Cantor Lectures, delivered before the Society of Arts.

Australia, he said, costs only from £3 to £4; and legs of mutton of the very best quality were, when salted, sold for 3s. a dozen. If some simple and practicable means could be devised for preserving such meat, it might be supplied to our markets at less than 3d. a pound.

Until recently, the only process employed for this purpose was the rude method of salting the meat, but the deterioration of it was so obvious, and the distaste for it so general, that it was only practised to a limited extent, and for occasions when fresh meat could not be obtained. The salt junk of the navy in olden time was a good example of the wretchedly unwholesome and indigestible meat prepared, for it could hardly be called preserved, by this process. Recognizing, therefore, the necessity for a better means of preserving food, the naval authorities of every country appealed to science, and gave the largest encouragement to inventors. A further stimulus to invention was created by the necessity for supplying our Arctic explorers with good and wholesome food during their long winter residence in the frozen seas of the North; and as that inquiry was set on foot, not merely for the purpose of discovering a north-west passage to our possessions in America, but also with the view of prosecuting scientific research in almost inaccessible regions, an unusual inducement was offered for the preparation of such food. The demand thus created was soon acknowledged by science, and was also met by the practical skill of the manufacturer, so that the Arctic voyager went confidently on his journey, knowing that he had other food than the unwholesome junk of the navy. The earliest preparations supplied to him were mixtures of dried meat with sugar and spice (pemmican), but after a time they were furnished with fresh meat preserved in air-tight cases. At first the supply was chiefly for voyagers in cold countries, but when the value of this method of preservation became known, the European residents of hot climates, as India, eagerly sought for the fresh foods which they were accustomed to use in their own country, and thus an additional stimulus was given to this process of manufacture. At the present time it has acquired gigantic proportions.

I have before me a list of the specifications of patents relating to the preservation of food, from the year 1691 to the end of 1855, and I find that only one was described in the seventeenth century, and three in the eighteenth, while as many as 117 were specified in the first fifty-five years of the present century. Invention, however, has not been prolific of new processes, for it is mainly confined to an application of one or two simple elementary principles—26 of the patents, for example, are for the preservation of food by drying; 31 by excluding atmospheric air; 8 by covering the food with an impervious substance, as fat, extract of meat, gelatine, collodion, &c.; and 7 by injecting meat with various salts.

But before we proceed with the examination of these processes, it will be advantageous to inquire a little into the circumstances which favour organic decomposition. It would seem, from experiment and observation, that three concurrent conditions are absolutely necessary for active putrefaction—viz., the presence of much moisture, the access of atmospheric air, and a certain temperature, as from about 40° to 200° of Fahrenheit; any of these being absent, the organic substance resists decay. All preservative processes must, therefore, depend on an application of one or other of these principles; and perhaps we may add a fourth—viz., the action of chemical agents. Let us review them in detail.

1st. The preservation of substances by drying them

is of very ancient date. In our anatomical museums we have long known that specimens of the animal body may be preserved for an indefinite time by drying them, and then varnishing them so as to exclude the moisture. Here is a dissection prepared in that manner, which has been used for lecture illustration at the London Hospital for more than half a century, and yet it is as sound as when it was made. In warm climates it has been a practice for ages to preserve fish, and even meat, by drying them—the meat being cut into strips and exposed to the action of warm dry air. Charqui, or South American beef, which you see here, is an example of it. It is obtained from animals that are grass-fed, and they are killed by pithing and then bleeding them. Directly the hide is taken off, the flesh is stripped from the bones and allowed to cool. It is then placed on a table, and jerked, or cut up into thin slices, which are piled up in heaps with alternate layers of salt. After standing twelve hours the meat is turned, and fresh salt is added where necessary. The next day the salted strips are placed upon hurdles, and exposed to the sun to dry. It requires two or three days to dry the meat thoroughly, and, for fear of damp, it is always taken indoors at night. There are several varieties of this meat—as *pato*, which is the best and most free from sinew; *manta*, the second quality; and *tasajo*, the third, which is very thin and full of sinews. All the varieties require to be well soaked in water, and then to be cut small and cooked by prolonged boiling. But animal foods are not well preserved in this manner, as they lose their flavour, and become tough and indigestible; the fat also gets rancid, and in damp weather the meat absorbs moisture and becomes mouldy and sour. Perhaps the lean parts of meat—as the heart, tongue, and strips of muscle—might be advantageously preserved in this way, especially in warm and dry climates. The Food Committee of this Society reported favourably of a specimen of dry powdered beef from Queenstown, which they said was in excellent condition, and contained about four times as much nutritious matter as ordinary meat. Generally, however, the fat is very rancid, even when pains are taken to prevent the substance from getting mouldy. It is for the same reason that all attempts to preserve milk and the yolk of eggs by drying have failed, although the dried white of egg will keep well, as in the process of Mr. Charles Lamont, where the albumen is dried in thin scales—forty-four eggs making about 1 lb. of the preparation. Absorbent substances mixed with the fatty food will obviate the difficulty to some extent, as in the preparation of pemmican, where sugar and spice are added to the dry powdered meat; and in the several processes for preserving milk by evaporating it and mixing it with sugar, &c., as in the patents of Newton (1835), Grimwade (1847 and 1855), Louis (1848), &c.; as well as the process of Davison and Symington (1847), for preserving eggs by mixing the yolks and whites with flour, ground rice, or other farinaceous substance, and drying. Extract of meat also may be preserved in the same manner, as in the patent of Donaldson (1793), of Robertson (1851), and of Borden (1851), where the extract, after the separation of fat, is mixed with farinaceous matters; in the last case it is also baked in the form of biscuits. In the year 1854, M.M. Blumenthal and Chollet obtained their patent for combining meat and vegetables in the form of tablets, by first drying the vegetables and pressing into cakes, and then submitting them to successive immersions in rich soup—allowing them to dry in warm air after each immersion. When the extract of meat is made without fat or gelatine, as

in the case of Liebig's extract, it may be kept for a long time in a pasty condition, without mixing it with farinaceous matters, although the preparation of it with baked flour, as already described, is a great improvement.

The process of drying is, however, best adapted for the preservation of vegetable substances, and it has been so used from time immemorial, as in the keeping of pot-herbs, in preparing the tea-leaf, in making hay, &c. In this country, the first recorded patent for preserving vegetables by drying them was granted in 1780, to John Graefer, who sought to retain the flavours of vegetables by first dipping them in boiling salt and water, and then drying. Forty years later (1820) John Vallance obtained a patent for preserving hops by drying them, and then compressing them into a small space. Then came the patents of Edwards (August, 1840), for boiling, granulating, and drying potatoes; and of Grillett (November, 1840), for preserving both cooked and uncooked potatoes by drying. Ten years afterwards (in November, 1850), Masson obtained his patent for preserving vegetables by drying them and forcibly compressing them, so that they were reduced to one-seventh their original bulk—a cubic yard containing rations for 16,000 men. This process has been very successful, and it is still practised by Devaux, Chollet, and others, for it serves for the preservation of all kinds of vegetables—as potatoes, cabbages, carrots, cauliflowers, beans, apples, &c.; and when steeped in water they re-absorb their natural proportions of moisture and swell out to their original size. They are, however, somewhat deficient of flavour, and they require prolonged boiling, as from one and a half to one and three-quarter hours, to cook them.

By a more careful process of drying, Mr. Makepeace has managed to preserve both the colour and the flavour of vegetables, especially of pot-herbs, as you may see from these specimens.

Altogether there are, or have been, about thirty-one patents in this country for the preservation of various articles of food by drying them.

2nd. The preservation of organic matter by excluding atmospheric air is, like the last, a very ancient process. The old practice of burying the dead in leaden coffins, and the still more ancient custom of swathing them in resinous bandages or waxed cloths (called *cerements*), owe their preservative powers to the exclusion of atmospheric air; and it is remarkable, seeing the efficacy of the process, that the scientific principle of it was not long ago recognised and applied to the preservation of food. The first patent of the kind that I am acquainted with in this country, was granted to Francis Plowden, in June, 1807; and he describes it as a process for "preserving butchers' meat, animal and other comestible substances, by encrusting them with a substance, which must not only resist the effects of atmospheric air, but must not communicate any noxious quality to its contents," and for this purpose he employed essence or extract of meat—the substance being dressed, so that it may preserve the longer, is wiped dry, and put into a wooden vessel, and the hot extract is poured over it in a fusible state, so as to find its way into every vacuum. Three years later (in February, 1810), Augustus de Heine took out the first patent for preserving meat, by exhausting the air from the vessel containing the meat, and he contrived a machine for the purpose, as the action of the common air-pump was tedious. Six and thirty years after this (1846) the late Mr. Warington, of Apothecaries' Hall, obtained his pat-

ent for the preservation of animal substances, by coating them with common glue, gelatine, or concentrated meat gravies, or otherwise by dipping them in warm solutions of such substances; or by wrapping them in waterproof cloth, or covering them with caoutchouc, gutta-percha, or varnish. These mark the starting-points of the various processes now in use; for example:—

(a). Of those which owe their operation to the exclusion of air, by filling up the vessel with something hot, there are the patents of Plowden (1807), who used rich gravy or extract of meat; of Granholm (1817), who used hot fat or hot animal jelly; and of Wothly (1855), who used oil, as in preserving anchovies. I am rather surprised, considering how easily the exclusion of air is effected by surrounding the substance with hot fat, that this method of preserving meat has not been adopted in Australia and South America; for as the fat which they prepare from their wild stock is sent to this country in casks, there would be no difficulty in sending with it the finer descriptions of joints, as legs of mutton and good pieces of beef. The process should be conducted as follows:—When the fat is melted, and is at a temperature of from 240° to 250° Fahr., the fresh joints should be plunged into it, and kept there for a few minutes, so that the superficial moisture might be thoroughly evaporated. They should then be immediately packed in sound dry casks, and filled up with hot fat, at a temperature of 212° or thereabout. In this manner the fat and the joints might be transmitted to this country, and on their arrival there would be no difficulty in melting the fat while in the casks, and then removing the preserved joints.

Vegetable substances are frequently preserved in bottles filled up with hot syrup, and the practice is a very old one. Hot water is also used for the same purpose, and this method dates from the year 1807, when this Society gave a premium to Mr. Saddington for his method of preserving fruits without sugar. His process was to gather the fruit a little before ripening, and to put it immediately into clean bottles,—filling the bottles with the fruit to the neck. They were then placed in a vessel of cold water, and heat was applied until it rose to the temperature of 160° to 170° Fahr. After standing exposed to this temperature for half an hour, the bottles were filled up to within an inch of the top with boiling water, and were then immediately corked and covered at the top with cement. The action of the heat was not merely to expel atmospheric air from the bottles, but also to coagulate the vegetable albumen of the fruit. Fruits and green vegetables are still preserved in this manner, a little alum being generally added to the water in the bottle for the purpose of hardening the tender skin of the fruit, and so preventing its disfigurement by bursting.

(b). A process not very unlike the preceding is that which consists in the destruction of the oxygen of the air in the vessel by heating the substance in it. This is the plan of M. Appert, who, in 1810 (three years after the publication of Mr. Saddington's method), obtained the reward of 12,000 francs, offered in the preceding year by the French Government, for the best method of preserving food. Here is the book which M. Appert wrote at the time, and he tells us to cook the food to some extent, and put it into strong glass bottles—filling them almost to the top. The bottles are then to be securely corked, and exposed for some time to the action of boiling water. To guard against accident from bursting, the corks are to be wired down,

and the bottles wrapped up separately in cloths. After this the corks are to be well covered with pitch, to exclude atmospheric air. A like process was patented in the autumn of the same year (1810), by Mr. Peter Durand, who, no doubt, derived it from the published account of M. Appert, dated nine months before; and since then many such patents have been obtained, whice I need not describe. Attempts have frequently been made to preserve milk by this process. Appert recommended that the milk should be boiled down to about half its bulk before putting it into the bottles; and in 1847 Bekaert tried to improve the process by adding carbonate of soda to the milk. Later still, in the same year, Martin de Lignac obtained a patent for preserving milk, by evaporating it to one-sixth of its bulk before bottling it. Then there were the patents of Symington and of Moreau (1853), but all these methods have failed in practice on account of the difficulty of preventing the separation of the butter.

(c). The preservation of food by exhausting the air from the vessel containing it dates, as I have said, from the year 1810, when Augustus de Heine proposed to use a vessel with a valve in the top of it, which allowed the air to be drawn out by means of a special apparatus, but not again to enter. The exhaustion, however, was so imperfect that the process did not answer. In 1828 Mr. Donald Currie improved it by admitting carbonic acid gas into the vessel after it was thoroughly exhausted; and later still, in 1836, M. Leignette still further improved it, by filling the vessels containing the food with salt and water, and then letting out the liquid through the aperture, which remained open for that purpose, while carbonic acid gas went in. Six years after this (in 1842), Mr. John Bevan patented a process for drawing out the air by an exhausting apparatus, and then admitting a warm solution of gelatine, and in 1846 Mr. Rettie employed, in like manner, a solution of common salt. But none of these methods were successful; nor was the patent of Mr. Ryan, in 1846, for using gases, chiefly acetic acid vapour and carbonic acid gas. The most perfect process of this kind was patented by Messrs. Jones and Trevethick. It consists of an apparatus whereby the exhaustion of the vessel containing the raw food is effected in an air-tight trough of water, and thus the entrance of air and the collapse of the sides of the vessel are completely prevented. After the exhaustion pure nitrogen is admitted into the vessel, for the purpose of diluting the residuum of air, and it is again exhausted. Lastly, a charge of nitrogen, containing a little sulphurous acid, is let into it, and thus the last trace of oxygen is chemically absorbed. The vessels are now in a proper condition for removal from the air-tight water trough and for having the apertures sealed with solder. Meat, fish, and poultry preserved in this manner has been found good after seven or eight years; and specimens of them were exhibited in the London Exhibition of 1862.

(d). The most common method of driving out the air is by means of steam. The food is put, with a charge of water, into a tin case with a hole in the top, and when the water is boiling actively, and steam has displaced the air, and is escaping freely, the hole is stopped with solder. This process dates as far back as 1820; but the first patent for it was granted to M. Pierre Antoine Angilbert, in 1823. He had, however, a very rude method of applying heat to the tin vessels, and this was improved by Wertheimer in 1840. In the month of January of the year following, Mr. Gunter improved it further; and later in the same year both Goldner

and Wertheimer obtained patents for using a bath of muriate of lime for heating the vessels. This, in fact, is the practice at the present time by Goldner, McCall, Richie, Morton, and others, who are largely engaged in the preservation of food. The details of the process for effecting it are as follows:—The raw meat and vegetables are put into the canisters and soldered down—a pin-hole aperture being left in the lid. The canister is then subjected to the heat of the bath (a little above 212°) until the contents are about two-thirds cooked; and then, while the steam is blowing freely out, the aperture is dexterously sealed tight with solder. The canister is then painted over with a stiff oil paint, and is exposed for some time in the testing room to a temperature sufficiently high to promote decomposition. If the canister shows no sign of bulging out from the generation of putrefactive gases, it is considered sound. Messrs. Hogarth and Co., of Aberdeen, use steam instead of the muriate of lime bath.

Meat preserved in this manner will keep for a considerable time. At the Exhibition of 1851 vouchers were given for some of the samples that had been preserved for twenty-five years; and at the Exhibition of 1862 I examined specimens of food that had been kept for more than thirty years. To-night, through the kindness of Messrs. Crosse and Blackwell, I am able to show you a specimen of preserved mutton which has been in the case forty-four years, and you will perceive that it is in excellent condition. It formed part of the stores supplied by Messrs. Donkin and Gamble in 1824 to his Majesty's exploring ship "Fury," which was wrecked in Prince Regent's Inlet in 1825, when the cases were landed with the other stores, and left upon the beach. Eight years afterwards (in August, 1833), they were found by Sir John Ross in the same condition as they were left; and he wrote to Mr. Gamble at the end of that year saying "That the provisions were still in a perfect state of preservation, although annually exposed to a temperature of 92° below and 80° above zero." Some of the cases were left untouched by Sir John Ross; and after a further interval of sixteen years, the place was visited by a party from H.M.S. "Investigator," when, according to a letter from the captain, Sir James Ross, "the provisions were still in excellent condition, after having laid upon the beach, exposed to the action of the sun and all kinds of weather, for a period of nearly a quarter of a century." Messrs. Crosse and Blackwell have placed the original letters in my hands for perusal, and they show, beyond all doubt, that meat preserved in this manner will keep good for nearly half a century—in fact, the case of boiled mutton now before you has been preserved for forty-four years. There can be no question, therefore, as to the success of the process; and hence it is largely practised, not only in this country, but also in our colonies, where food is abundant. In this way preserved salmon and lobsters are sent to us from Newfoundland, turtle from Jamaica, beef and mutton from Canada, and the dainty tail of the kangaroo from Australia. There are, however, two serious objections to the process—namely, that the meat is nearly always overcooked, and the cases are likely to buckle and crack from the constant pressure of the atmosphere—there being a vacuum within them. The over-cooking arises from a desire to ensure the complete exclusion of atmospheric air by the steam. Mr. Nasmyth has proposed, in his patent of 1855, that a little alcohol should be mixed with the water, so that the boiling-point may be reduced; while Mr. McCall, taking advantage of the absorbent action of sulphite of soda on oxygen, re-

commends a less prolonged boiling and the use of a little of that salt. The salt is contained in a small capsule, fixed by means of soft solder to the inner surface of the cover of the case. When the food is about two-thirds cooked, and steam is freely escaping, the hole in the lid is stopped with a very hot iron, which melts the soft solder of the capsule within, and so sets free the little pellet of sulphite of soda, which speedily absorbs the remnant of oxygen left in the case.

The other difficulty, namely, the cracking of the case from atmospheric pressure, is obviated, as I have already explained, by the introduction of inert gases, as carbonic acid, nitrogen, &c., and with a little sulphurous acid, and these have been the subject of many patents, as of Currie (1828), Leignette (1836), Ryan (1846), Nasmyth (1855), and others.

(e). The last method of any importance for excluding atmospheric air from food is by coating it with some impervious material. This plan, as I have already stated, was first suggested by the late Mr. Robert Warrington, who in March, 1846, obtained a patent for the use of "common glue, gelatine, or concentrated meat-gravies; or thin cream of plaster-of-Paris, which, when set hard, was to be saturated with melted suet, wax, stearine, &c." "The things were then to be wrapped in water-proof cloth, or covered with caoutchouc or gutta-percha; or coated with a varnish of these substances; or kept submerged in glycerine, treacle, elaines, oils, or other such matter not liable to oxidation." Nine years after this, in January, 1855, a patent was obtained by Messrs. Delabarre and Bonnet for preserving meat, bread, eggs, vegetables, or pastry, by coating them with a varnish made from the flesh and bones of animals, by boiling them, and obtaining a rich syrup. This, when clarified, was used to cover the parboiled meat or vegetables. In the month of February in the same year, a like patent was granted to Mr. Hartnall for a process of preserving animal and vegetable substances by immersing them in baths, consisting of gelatine and treacle dissolved together in certain proportions; then drying, re-dipping, and covering with charcoal powder. Later still, in the same year, Mr. Brooman patented the use of albumen and molasses as a coating for meat, after the meat had been partially dried, and then suspended in an air-tight vessel charged with sulphurous acid. Lastly, in the month of December of the same year, Messrs. Bouëtt and Duocin obtained provisional protection for the use of collodion, either alone or mixed with other suitable substance.

But the best example of this method of preserving meat is the process of Dr. Redwood, whereby the meat is first covered with paraffin, and then with a flexible coating of gelatine, mixed with glycerine or treacle. The joints are dipped into a bath of paraffin having a temperature of from 240° to 250° of Fahrenheit, and are kept therein until the surface moisture is evaporated. They are then transferred to a colder bath of paraffin, from which they receive two or three coatings prior to their being covered with the last flexible covering of gelatine, &c. When the meat is required for use, the paraffin is easily removed from it by plunging it into boiling water, which dissolves the flexible coating and melts the paraffin. The paraffin floats upon the water, and, when cold, may be collected for future use.

The common methods of preserving foods by forcing them into skins, as in the case of German sausages, lard, &c., is of very ancient date, although a patent was granted to Mr. Palmer in 1846 for the preservation of the fat of beef, mutton, veal, or lamb, when fresh, by melting them, straining, and then packing in bladders.

3d. The preservation of food by cold is a well-known process, for every one is acquainted with the fact that meat will keep for a long time in the winter season without deterioration; but the extent to which this preservative power may be carried is not well known. Animals, we are told, have been found in a perfect state of preservation in the frozen earth of the arctic regions, where they must have been buried for centuries. Last year, indeed, a communication was made to the Royal Society by Dr. Carl von Bear of the fact that the entire body of a mammoth was found in the frozen soil of Arctic Siberia. How long it has been so preserved it is hard to conjecture, but it must have been there for ages. Another good example of the preservative power of cold was observed in Switzerland in the autumn of 1861, when the mangled bodies of three Chamounix guides were found at the lower part of the Glacier de Boissons. The flesh of the bodies was perfectly preserved, notwithstanding that 41 years had elapsed since the unfortunate men lost their lives. They were carried away by an avalanche from the grand plateau of Mount Blanc, in the month of August, 1820, while attempting to ascend the mountain with Dr. Hamell; and no trace of them was discovered until the corresponding month of 1861, when, by the slow descent of the mountain ice, their remains were brought to the lower glacier. So well is this preservative power of cold known to the inhabitants of Russia, Canada, and other northern climates, that it is a common practice to slaughter fat animals on the approach of winter, when fodder is getting scarce, and to preserve their carcasses by burying them in the ice or frozen earth; and they are thus preserved from the middle of November to the early part of May. We also have a practice of packing salmon in ice; and we receive game and poultry from America, and send the like to India in boxes surrounded with ice. The application of this method of preserving food is almost without limit, for not only can we obtain a stock of ice for such a purpose in the winter season, but it may be brought to us at any time from colder regions of northern Europe, or it may even be manufactured at a cost of less than half-a-guinea a ton. There is a machine of Mr. James Harrison, of Australia, made in this country, which is said to be capable of producing 8,000 lbs. of ice a day, at a cost including all expenses, and with a good margin for profit, of ten shillings a ton. Why, therefore, may we not use ice in the summer months for the preservation of food? Dealers could easily provide themselves with close rooms containing ice, in which the food might be placed; and we ourselves might use ice-boxes more commonly in our households. It might interest you to know that the first patent for the preservation of food in this manner was granted to John Lings, in 1845.

Again, a temperature of from 200° to 212° will also arrest putrefaction; and joints of meat may be preserved for a time by dipping them every now and then in boiling water.

The fourth and last method of preserving food is by the use of chemical agents, called antiseptics, which act by destroying infusorial and fungoid life, and by forming compounds which are not prone to decay. Foremost of these is common salt, which has been used from the earliest time; but it is not a good agent for the preservation of meat, as it renders it tough, gives it a bad flavour, extracts the soluble constituents of it, and makes it hard and indigestible. The process, however, is much better managed at the present time than formerly, when the hard junk of the navy was the common-

respects. The researches of Roscoe on Vanadium are accurately set forth, and compared with those of Berzelius, a very interesting summary is the result, and we would call our readers' attention to the matter. In Dr. Miller's list of elements, Roscoe's equivalent number is preferred to that of Berzelius, but the theoretical plan claimed by Dr. Roscoe is not allowed; Vanadium is not only not placed in the nitrogen family, but it is excluded even from the elements called triads. Its claim to this position is surely as strong as that of chromium or manganese to the hexad, or of iron to the tetrad group.

Another most interesting paper is also given to us in a concentrated form, relating to chemical change in solution—we allude to the papers of Messrs. Harcourt and Esson—which from their philosophic accuracy of detail well merit a careful study.

It may be observed, in passing, that Dr. Miller generally gives references to the original sources from whence he obtains the information he gives us; this is a valuable feature of the work, and the future value will be still further increased by an extension of this principle of giving references to the sources where full information may be obtained. It is true that all these may be found in Watts's "Dictionary," but they would also be useful here for the student, who has not always ready access to that work; we urge this chiefly on behalf of such students.

We hope that a too rigid method of adhering to the plan of arrangement of the three volumes will not limit the usefulness of each separate volume; a little repetition of matter is often necessary, and no one is more qualified than Dr. Miller to give us the characteristic spectroscopic tests of metals, &c., which may fairly be placed side by side with specific gravity and conducting power in the physical history of each element or compound.

One of our favourite sections in the second part we are pleased to find added to, and made more interesting—we allude to the section treating of the equivalent weights of the elements as given by different authors and their different processes. The use of the new expression in the present edition of non-metals as opposed to metals, gives, we hope, the death-blow to that word of exotic growth "metalloids."

In conclusion, we congratulate Dr. Miller upon his success in improving the work that has always been one of the chemists' best and most intimate friends.

"A Manual of Elementary Chemistry, Theoretical and Practical," by George Fownes, F.R.S., late Professor of Practical Chemistry in University College, London. Tenth edition, revised and corrected. London: John Churchill and Sons, New Burlington Street, 1868.

THERE is probably not a student of chemistry in this country to whom the admirable manual of the late Professor Fownes is unknown. It has achieved a success which we believe is entirely without a parallel among the scientific text-books in our language. This success has arisen from the fact that there is no English work on chemistry which combines so many excellences. Of convenient size, of attractive form, clear and concise in diction, well illustrated, and of moderate price, it would seem that every requisite for a student's handbook has been attained.

We have before us the ninth edition published in 1863, with which to compare the tenth edition which has just been placed in our hands. The ninth edition was published under the joint editorship of Dr. Bence Jones and Dr. Hofmann, the new one has been superintended through the press by Dr. Bence Jones and Mr. Henry Watts.

It is not too much to say that it could not possibly have been in better hands. Dr. Bence Jones has been connected with this work as editor since the third edition published in 1850, and it is evident that the task of watching over its subsequent editions has been a labour of love. The name of Mr

Watts now appears in the work for the first time, but it needs no great prophetic powers to foresee that his connection with it will not cease with the present issue. There is no one in England who can compare with Mr. Watts in experience as a compiler in chemical literature, and we have much pleasure in recording the fact that his reputation is well sustained by this, his last undertaking. The ninth edition of "Fownes" contained 820 pp.; the tenth contains 1020 pp., and is probably as bulky as it is desirable that a student's text-book should ever be.

The opening chapters on "Density and Specific Gravity," remain pretty much in the state in which they were in the ninth edition; the chapter on "Heat," however, is much altered: Regnault's important experiments on the amount of heat requisite to convert water of any given temperature into steam of the same or another given temperature have been noticed, and Fahrenheit's scale has been in many places discarded for the centigrade. A table exhibiting the melting points of several substances, and their latent heats of fusion, "expressed in gram-degrees," has been introduced, and will be found useful. Under the head "Sources of Heat" Joule and Mayer's researches on the mechanical equivalent of heat have been explained clearly and concisely, and, altogether, this section has been greatly improved.

The article "Light" has also been increased by additional matter on the interesting subject of absorption spectra.

When we come to the chemistry of elementary bodies we see at once in the section on oxygen, that the work before us has undergone a radical change—a change rendered absolutely necessary by the universal adoption of the new notation in all chemical schools of any importance. Ozone is also noticed at much greater length in this edition.

Under hydrogen we were much pleased to find that the important phenomena of occlusion, studied by Deville and Troost, and Graham, have been done justice to. The beautiful experiment by which the latter chemist obtained hydrogen from the meteoric iron of Lenart is described in this place. To show how carefully the work has been edited, we may mention that the plate of curves indicating the solubility of salts in 100 parts of water, has been re-engraved, in order that the names of the salts may be in harmony with the nomenclature adopted throughout the work.

As may be supposed, the article "Carbon" has been almost entirely re-written to bring it into accordance with the new views; moreover, the article on "Combustion and the Structure of Flame" is made to occupy its natural place after "Carbon," instead of being separated from it as in the ninth edition.

We need not say that the well-known section on "The General Principles of Chemical Philosophy" has been re-written and much extended. In the ninth edition this subject was condensed into twenty-one pages; in the one before us it occupies thirty-one pages, and it is one of the best expositions in our language of the views at present received.

In passing we may mention as showing the strides that have been made even in metallic chemistry, which certainly does not progress like the chemistry of the compounds of carbon, that the article "Thallium" which, in the ninth edition, was condensed into less than one page, in that before us occupies five pages, and takes its place under "Triad Metals," the metals being grouped in accordance with their atomicity, as monads, dyads, triads, tetrads, pentads, and hexads.

As may be expected, it is when we come to the organic chemistry that the most sweeping changes are manifest. In fact, here we can scarcely recognise our old friend "Fownes." The limits of this notice preclude the possibility of recapitulating all the changes that have taken place. The whole system has been re-modelled to keep pace with the rapid strides which organic chemistry has made. As we wish our readers to see clearly the admirable and conscientious manner in which the editorial work has been accomplished, we have endeavoured to find a characteristic article for quotation, and

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ACCURACY.

ACCURACY and knowledge of detail are the great aims of modern scientific men. There may be much that is indefinite, but, when accuracy comes, every opposing speculation and supposed law or fact falls as hopelessly before it as that celebrated road to the skies which was felled to the earth by a well-aimed blow from Jack's hatchet. Speculation in its early meaning is seldom heard. Thought must stand on scientific ground and follow a scientific line; if it is diverted it must be at angles which accord with the logic of nature.

We sometimes like before looking at our own age to glance at that which is past. It is pleasant to associate ourselves with our brethren, however far separated. If we wish to know the history of our own thoughts we trace them back in our minds, and if we wish to know how the world learned to think we must look to the ages which preceded the building of our ideas. There is, however, another reason not so purely logical, but perhaps more powerful. There is a richness in these early thoughts because they have a tint of the eastern sun which never fades, and we shall admire their brightness whilst time lasts, or until that day when the poet comes who shall exhaust in his writings the delight which children have in the fields and the sunshine.

In early days of the world thoughts were not enchained by experiments, and great wide souls made boundless systems which endeavoured to include the infinite magnitudes that presented themselves to view in time and space. The warm colours were obtained from the fire in which they were smelted, although the heat itself has been quenched with an unheard hiss in the western seas. If we admire order, here is an idea stately and great; perhaps the formality, and, if we add also, the imperial dignity, are among the early modes of seeking logical order and extreme accuracy. The Desatir is said to mention a system of the heavens in which each star reigns for a thousand years, and has besides one star for a prime minister; and when every heavenly body shall have gone through the two offices of minister and ruler one great heavenly period shall have been accomplished. Every year is made of days, which days again consist of one revolution of Saturn or nearly thirty years. Every year, therefore, was above 10,000 of our years. Precision in form was taken for accuracy. On this point it is to be feared that even chemists may err. Part of the above shows a desire to comprehend the infinite, and we do somewhat the same when we think of the most probable—if not well proved—central cosmic sun round which our own system revolves.

The classical ancients seemed to seek accuracy by a very different method, and, unable to comprehend the infinite any more than their eastern forefathers, they determined at least to throw away the indefinite or vague, and this they did by making the sayings and doings of the celestials as trivial and useless as their own. The reasoning faculty has little reverence, and when it cannot grasp the wonderful it throws it aside, for the same reason as the hard uncle left the babes in the wood.

The north, like the east, had no desire to diminish the wonderful, but, perhaps, when they talked of the lights of heaven being pursued by a wolf who would swallow

up the moon, they meant no more by that great capacious throat than our own stern Carlyle means when he uses such an expression as "infinite abyss." They must, however, bear the blame of inaccuracy of words. The Greek mind reduces all wild solemnities to the most unromantic common place, and thereby brings us out of much folly into plain common sense. Hear the complaint of the moon in the second century. "My patience is worn out by the philosophers who are perpetually disputing about me—who I am, of what size, how it happens that I am sometimes round and sometimes full, at other times cut in half; some say I am inhabited, others that I am only a looking-glass hanging over the sea, and every one seems to fit on me any notion they may have. They even say that my light is another's and stolen from the sun, not hesitating to set me and my brother in opposition. For it is not right that they should call the sun a stone or a red-hot clump." It was centuries before this that the sun had been called a red-hot stone as large as the Peloponnesus. We in our time cannot differ far in principle from this view, and it has taken very long indeed to make steps in accuracy regarding the constitution of the heavenly bodies; still we tend to it. It would seem as if the world had always a large amount of matter standing for facts. We take pleasure in looking at an old chemical work, "Dictionnaire de Chimie," of the "Encyclopédie Méthodique," begun in 1786 on such a scale that the first volume, quarto and double-columned, and of 773 pages, goes only the length of the word "Airelle." Then knowledge was actually as bulky as now, although, perhaps, no sentence is written with accuracy. They had enough to say to fill their minds;—nay, we may go very much farther back, and for mere curiosity let us quite at random take up Pliny, who knew everything of his time in a rough way, and let us ask the cure for any common pain—say headache—we are not disappointed. The remedies are abundant. The heads of slugs or wool grease, or the bones of a vulture's head, or its brains mixed with oil and cedar rosin and applied to the head and nostrils; more are given equally promising, and some pretending to great accuracy, such as "the small bone from the head of a snail that has been found between two cart ruts, and after being passed through a gold ring with a piece of ivory, is attached to the patient in a piece of dog's skin, a remedy well known to most persons, and always used with success."

The whole course of thought is now changed among men who have received even a tinge of science, but the spirit of old times is not quite forgotten. There must be many men who remember in early days that it was enough to bring forward a good quotation when they wanted a proof, and there must be many who know minds incapable of seeking any other proof. There are in Europe superstitions exactly of the kind mentioned, some of them blended with forgotten knowledge, some wholly fantastic; it is the business of science to remove them and bring more accuracy. Modern astronomy is built on a basis of very careful observation and calculation, but we have never been able to find that modern astrology had even a semblance of a basis. It is even far behind the ancient in its attempts at proof. It seeks none, whereas in the East it is said that star watchers sat carefully observing the heavens whilst others gave notice of the birth of a child, in order to know exactly at what aspect of the skies it came into the world. This would produce a science founded on fact, or it would put an end to

the whole. Without a trace of experiment, men wealthy enough to promise large sums come even now to astronomers to know the course of future events, but they will not give the money to a good tutor to relieve them of their ignorance.

It is difficult to measure the distance between this merchant consulting the astronomer, and the astronomer himself, who has a difficulty in making his visitor understand that he cannot read the future. Let us say the difference is two thousand years. Let us also pause a moment to consider the progress made by the astronomer in two thousand years. Perhaps the first man that counted by seconds was one who found the pendulum to be his own heart—a heart quietly beating, after the violence of youth was over, sixty times a minute. The period of one beat has become for mankind a symbol of shortness; it is a length of time passing too rapidly to be calmly surveyed, and to speak of the movements in the sky to such accuracy was not to be thought of. There was no mode of measurement. Now the ear itself has become critical beyond the heart, and it dares to measure to one-tenth, whilst the intellect, with a refinement beyond its own full comprehension, divides the same period into a million, and the strange laws of nature placidly permit that mechanism shall be formed for the purpose. The man of the dark past, although he is living now amongst us, may have heard that from the great distances in space we see in stars that which has existed many years ago, and may think that we have only to turn the telescope and, by looking the other way, see equally far into the future. We have sympathy even with him, and we too would like to know the future of chemistry and even of man.

But we are among chemists and not astronomers, although when we look far back chemistry offers us few illustrations. Since we first took up a piece of earth and said to ourselves "of what is this made?" we have a long line of men, each striving to be more accurate than his neighbour. We do often wish that we could take up a history of these later men, written not merely in English but by Englishmen who had read and weighed everything for themselves. For our facts we must go either to the originals or to the Germans. We find in these rich volumes by Kopp abundance of matter well weighed, perhaps with as much justice to Englishmen as they could do themselves, but we should like to see it written with a warm heart towards our fellows, seeking out every corner as justice alone cannot, but as kindness only can. We turn to France, and there we find a history truly original also, but with a name that sounds truly German—it is Hoefer. Well, we cannot blame them: we are thankful.

We cannot see the tendency towards exactness and clearness better than by taking a chemist's view. Air was once the soul of the world, it was the life of man, it was a spirit including intellect, it was a ghost, it was capable of turning into water, which again became earth, and it was in itself nothing material, and had no weight or substance. Now it has fallen into the ranks of ordinary things, although not less wonderful. It has been divided into parts, although unseen. This very spirit of the world has been dissected, and chemists treat it without reverence, measuring it out in tubes or weighing it on balances. Now we can scarcely tell how various its composition. It has two principal parts, but a third was soon added, whilst a fourth, under the name of ozone, has been followed by the scent for many years—we may even say since those ancient days when the smell was observed after violent light-

ning. Now we have plants and animal diseases almost endless, and strange influences accompanying every wind. These by degrees the scientific inquirer is hunting down, and preparing for the world new museums in nature where we shall see, by the aid of magic eyes, forms of disease lurking around and capable of being successfully attacked instead of insidiously entering and finding no one to struggle against them. The air has been, and will long be a study worthy of the greatest and the most acute, but the progress made is a great triumph, and shows that scientific men in many departments are reasoning, on the whole, rightly and fairly, gaining a victory over the world.

We may say that all organic matter comes from the air, the trees, and the lower animals, and man himself; and when we have viewed this proof which chemistry has made we almost return to the original idea that the air is the life of the world, not by general and vague reasons but by careful analysis. Out of the air we may form or see formed by natural means thousands of bodies, each varied in its structure as we can prove, although air itself is invisible; and out of it will come many thousands more—movements of unseen bodies, directed by unseen forces, and observed by unseen minds. It is to this that we have come by accuracy to a world that was as unknown as if it were in Saturn, whereas we are in its midst, and the scales of our eyes only want removal to shew us the irresistible intelligences at work.

The wide and hasty flights of thought are past in many departments. The workers must walk softly. Our trail is not the broad foot of the elephant on the mud, but the slightly displaced leaf of the forest. With patience the chemist watches the drops from his filter and walks up and down on guard; with patience he observes that one-thousandth of the weight has been lost and that he ought to have lost less; he begins again. We do not wonder at Professor Rose being excited when a courtier walking about in his laboratory touched with exquisite forefinger a transparent precipitate of alumina on a filter. Stateliness of manners was forgotten. The chemist seized the offending finger, and never ceased to wash it with a jet of water till the earth was all returned to the funnel; nor could he venture to explain, since the jet was driven by his own mouth and swollen cheeks.

The idea of cleanliness in all its accuracy is known only to chemists. When preparing a substance for analysis is there any trouble that we avoid if we can aid success? What! in a vile laboratory? Yes; no foul air must touch these bodies. Air, that which the most sensitive persons would consider sweet, would be poison. The slightest trace of carbonic acid or moisture, things found in all breezes, would make some analyses imperfect. We can well remember when in that stage of learning when sulphur and hydrogen are so much employed for metals we rushed forward to seek advice, but were driven back from the sanctum by the usually most urbane and pleasant friend. What could that mean? he was preparing a silver salt in order to obtain an important atomic weight. We are obliged to use not only pure air, but sometimes artificial atmospheres, and sometimes the entire absence of atmosphere. As to analysis generally, most chemists have seen in their own day the rise of the methods of Fresenius. It was no easy matter to learn from that of Rose. The information was great, but the system deficient. Now the details and system of Fresenius seem to form an embodiment of logic itself, and if any

one learns them he must have learned to reason in such a way that he will gain a great superiority over his former self. Every step carelessly made shews itself in material mistakes; the student must reason closely to keep his solutions correct. He cannot go with mere enthusiasm and boasting long. His own results bring him the greatest reproaches, his experiments silently humble him, and he is laughed at by forces that he cannot avenge.

We see the value of accurate work in Berzelius perhaps more than in any man. He built up inorganic chemistry, and if any man follows his work in organic departments he will learn to wonder at its accuracy. He worked as if the eyes of posterity were on all his movements, and he seemed to be able to do his enormous labours by making few blunders. There is no chemist from whom the young can learn so much of the art of working long and honestly. We modify his structure, but it was said by one, himself a great man, "Berzelius is the greatest chemist that is, or that was, or that will be."

We remember sitting with an old philosopher, when he said, "Would you like to see the atoms of Epicurus, out of which the worlds were made—true star-dust?" Who would have said no? he brought a little bottle of meteoric dust—but we must not describe it; he will do it, or has done it. We thought of these atoms now visible to a microscope but still divided by the chemist in many portions, and long after the finest microscope can aid the finest eye the chemist goes on dividing, and with a certainty which is absolute.

It was our wish to shew that science is gradually making its devotees the representatives of care and accuracy. We have scarcely space to carry out the plan fully, but chemists are accustomed to such a variety of occupations that they can readily finish this article for themselves. It is a fine quality that of uttering undeniable truth. Let us not lower that position but rather magnify our office. Let our words suit the facts with an accuracy equal to that with which the facts themselves can be ascertained, and in a world of wavering and changing let us show that there is a class of facts to be found upon which reliance can be placed so far that we may be certain they will never change. In common affairs a mistake may have but a short life, but in the study of nature an imperfect observation may cause infinite trouble to thousands. The increased study of science will promote exact observation and greater love of truth among men, and will produce a race that will either absorb the worthless residuum or drive it hence into the unknown and unseen.

ON A MODIFICATION OF THE METHOD OF ASSAYING SILVER COMPOUNDS IN THE WET WAY.

BY M. STAS.

THE mode of testing in the wet way in order to fix the standard of silver substances, as established by Gay-Lussac, is open, under certain conditions, to a source of error, arising from the solubility of chloride of silver in the very liquid to which its origin is due. This solution, whatever its mode of production may be, is precipitated equally by a decimal solution of silver and by chlorhydric acid. The extent to which this precipitation ensues is uncertain. At the ordinary temperature, there may be a variation of from one to six thousandths in 100 c.c. of the liquid. Practically, it is quite possi-

ble, while still preserving the simplicity of the wet method, as invented by Gay-Lussac, to substitute a bromide for a chloride in precipitating silver, and thus remove absolutely those anomalies which have been observed to be attendant upon the use of a chloride or of chlorhydric acid.—*Comptes Rendus.*

ON THE ESTIMATION OF TITANIC ACID.

BY DAVID FORBES, F.R.S., &c.

THE results of numerous analyses of rocks and of the products arising from their disintegration and decomposition have proved thoroughly confirmatory of the observations by Mr. Riley, brought forward in his valuable paper "On the General Occurrence of Titanic Acid in Clays, &c.," published in vol. xv. of *The Journal of the Chemical Society*; and having myself, in the course of these investigations, paid considerable attention to the various processes employed for determining the presence and amount of titanic acid contained in mineral and metallurgical products, it is considered that the following remarks upon this subject may probably be of use to the analyst:—

As it still appears to be the common opinion, that, in the process of the analysis of mineral silicates, titanic acid when present does remain altogether, or in greatest part behind along with the silica which has been separated from the bases, it seemed, therefore, desirable to ascertain how far this actually was the case, and also whether any definite ratio existed between the amount of the insoluble titanic acid which remained behind with the silica and that which was taken up by the acid solution.

The result of the examination of several clays and rocks containing this acid, served to show that a very considerable amount of the entire titanic acid present in the substance analysed, did really enter into solution, and consequently that a material error would occur in the statement of the results of the analysis, if this amount was neglected, and merely the quantity remaining behind with the silica was assumed to represent the total percentage of titanic acid present in the substance under examination.

A single example will suffice to show that this is actually the case. Upon analysis, at the request of Mr. George Maw, F.G.S.,* of a red clay, which formed a stratum of from 7 to 8 feet in thickness, occurring at about the middle of the Shropshire coal measures at Calcotts, near Broseley, the following percentage composition was found:—

Silica, combined.....	29.71	} 64.06
" free.....	34.35	
Titanic acid, insoluble.....	0.37	} 0.62
" soluble.....	0.25	
Alumina.....	20.60	
Sesquioxide of iron.....	6.84	
Protoxide of iron.....	0.32	
Protoxide of manganese.....	0.09	
Lime.....	0.12	
Magnesia.....	0.04	
Potash.....	0.91	
Soda.....	0.44	
Water, with traces of organic matter.....	5.85	

99.89

From these results it will be seen that above 40 per cent of the entire amount of titanic acid present in the

* *Vide Quarterly Journal of the Geological Society*, vol. xxiv., p. 354, 1864.

clay had entered into solution, and was afterwards thrown down by ammonia (which precipitates titanic acid completely) along with the alumina and sesquioxide of iron obtained together in the course of analysis.

The method employed in separating the titanic acid from these substances, was simply to dissolve the precipitate of alumina, sesquioxide of iron, and titanic acid in dilute sulphuric acid, to neutralise a considerable portion of the excess of sulphuric acid by solution of caustic soda, then to add a few drops of nitric acid, which prevents the titanic acid subsequently precipitated, from carrying down with it more than a trace of sesquioxide of iron, and after still further dilution with a large excess of water, to boil for some time until all the titanic acid is precipitated in the insoluble form.

The insoluble titanic acid remaining with the silica was extracted from it, by boiling the silica in a platinum crucible for some time, with concentrated pure sulphuric acid, allowing it to cool, and then pouring the whole rapidly into a large excess of cold water so as to avoid any considerable rise in temperature of the solution; after filtration from the insoluble silica, the solution was nearly neutralised by soda, a little nitric acid added, and the titanic acid precipitated by boiling as before.

According to Marignac, titanic acid is precipitated from its solution in concentrated sulphuric acid after dilution with from five to six times its volume of water upon boiling, but it was found safest to neutralise a large portion of the excess of the acid by soda before boiling the solution, which, after filtration, was, upon subsequent testing, not found to retain any appreciable amount of titanic acid.

The results of various experiments, not only proved that the proportion of titanic acid dissolved, amounted to a very large percentage of the total titanic acid contained in the silicate, but also showed, especially when but very little titanic acid was present in the mineral or rock, that the amount which entered into solution might occasionally be much greater than that which remained behind with the silica. In all analyses, therefore, it becomes a matter of necessity to determine both the soluble as well as the insoluble titanic acid, in order to obtain correct results both as regards the amount of titanic acid present or also to obtain the true percentage of the silica, alumina, and sesquioxide of iron. Even when the total amount of titanic acid in a mineral has been determined by the usual process of fusing it with from eight to sixteen times its weight of bisulphate of potash, or, still better, bisulphate of soda (since the soda compounds are much more soluble), and afterwards boiling the very dilute solution of the fused mass in cold water, until all titanic acid is precipitated; there still remains the difficulty of knowing how much of the titanic acid thus found should be deducted respectively from the weight of the silica or from that of the mixed precipitates of alumina with sesquioxide of iron.

In these cases I have found the following mode of procedure convenient:—The mineral, clay, or rock reduced to an impalpable powder, is placed in a proper sized platinum crucible, and made into a very liquid paste with pure concentrated sulphuric acid; the whole is then kept for some hours exposed to a temperature sufficiently high to cause it to emit slight fumes of sulphuric acid without making it boil or spirt. By this means the entire amount of titanic acid present, combined or uncombined in the substance, appears to be converted into the soluble modification and is taken up by the sulphuric acid.

The whole is now allowed to become quite cold, the contents of the crucible is then discharged into a beaker glass containing so large an excess of cold water that no rise of temperature need be apprehended, and the crucible itself washed out with cold water. This solution is now filtered from the insoluble matter, consisting of silica along with any undecomposed silicate which may remain unacted upon by the sulphuric (and if much lime, strontia, or barytes, is present, some sulphates of these earths) acid; this should be washed, first with cold and then with hot water. The filtrate is now nearly neutralised by caustic soda and boiled for a considerable time, occasionally adding more water as evaporation takes place, so as always to keep the solution very dilute, until all the titanic acid has been precipitated.

Should much iron be contained in the solution, a little nitric acid should be added to the filtrate previous to boiling, in order to prevent the titanic acid carrying down with it more than a trace of sesquioxide of iron.

The titanic acid thus obtained usually retains some sulphuric acid, and should be heated with the addition of a little carbonate of ammonia to volatilise this acid; after ignition the titanic acid usually is of a light yellow colour, but should it present a deep red appearance, due to sesquioxide of iron carried down along with it, it should be fused with bisulphate of potash or soda, the fused mass dissolved in an excess of cold water, a few drops of nitric acid added, and the solution boiled, when it will be obtained nearly colourless or of a faint yellow tinge.

The insoluble matter obtained after treatment of the original substance may now be fused with carbonate of soda and potash as usual in the analysis of an insoluble silicate, taking care, of course, to add to its solution the filtrate from which the titanic acid has been precipitated by boiling.

In some cases, where but traces of lime or other element which would form a sulphate insoluble in water or solution of sulphate of soda or potash are present (zirconia thorina, &c.), the analysis may be made by fusing the mineral with about ten times its weight of bisulphate of soda or potash (preferably the former, from the easy solubility of its fused product), dissolving the mass in cold water and filtering it from the insoluble silica, which, after washing, first with cold and then with hot water, may be weighed after ignition as usual. From the filtrate the titanic acid is precipitated by boiling, some nitric acid having previously been added in case oxide of iron is present in any quantity, and after filtration the solution can be used for determining the bases, alumina, iron, magnesia, &c., as usual.

In estimating the amount of titanium or titanic acid in samples of cast or wrought-iron this substance has usually been sought for in the residue insoluble in acids, but the following experiments also prove that such a procedure cannot be relied upon as furnishing correct results.

A sample of cast-iron produced from smelting a titaniferous magnetite from Gullaxrud, in Norway, in a charcoal blast furnace, the complete analysis of which ore is given in the *CHEMICAL NEWS*, vol. xviii., No. 471, p. 276 (*Am. Repr.*, Feb., 1869, page 71), was taken, and 251.59 grains in small fragments dissolved in nitrohydrochloric acid; the insoluble residue was collected on a filter, incinerated, digested with sulphuric acid, and the titanic acid present determined as before described, when it was found to amount to 0.52 grains, equivalent to 0.207 per cent titanic acid or 0.126 per cent titanium.

The filtrate was now neutralised carefully with ammonia, and then a slight excess of ammonia added, so as to cause a small permanent precipitate of sesquioxide of iron to be formed, which was then filtered off from the ferruginous solution and washed. This precipitate, which contained all the titaniferous and phosphoric acid present in the iron, along with an excess of sesquioxide of iron, was now dissolved in a little very dilute sulphuric acid, some nitric acid added and the solution boiled; an immediate precipitate of titaniferous acid was formed which, when determined, amounted to 0.14 grains, or 0.056 per cent, equivalent to 0.034 per cent titanium. The examination of this cast-iron resulted in showing that it contained 0.207 per cent titaniferous acid in the insoluble form, and 0.056 per cent titaniferous acid in the soluble form, or a total of 0.263 per cent titaniferous acid, and that, consequently, more than 20 per cent of the entire titaniferous acid had been dissolved of the acids employed in the analysis.

Another sample of cast-iron produced from smelting the titaniferous magnetite from Christine Mine, near Krageroe, in Norway, was also examined with the same object in view. In this case 104.26 grains of the cast-iron in fragments were dissolved in nitrohydrochloric acid, and left an insoluble residue which, after incineration, weighed 2.47 grains; this was, as in the last case, digested in concentrated sulphuric acid; the titaniferous acid, which was determined as before described, weighed only 0.02 grains. The acid filtrate was then treated with ammonia, so as to precipitate a small amount of the sesquioxide of iron along with any titaniferous acid contained in the iron, and this latter, determined as in the former case, amounted to 0.03 grain.

The result of this experiment shows, therefore, that this cast-iron contained a total of only 0.048 per cent titaniferous acid (equivalent to 0.029 titanium) of which 0.019 per cent remained in the insoluble residue, whilst 0.029 per cent had been dissolved in the acid solution, confirming the previously arrived at conclusion, that when a very small amount of titaniferous acid is present in a substance, the major part of it is often, if not always, to be found in the solution, and not in the insoluble residue.

I have not been able, as yet (although I have made several experiments for the purpose), to prove satisfactorily that titanium alloys with iron, but the analysis of various samples of cast-iron, wrought, bar, and steel smelted from ores containing titaniferous acid in considerable quantity, appears rather to indicate that the small amount of titanium which they really do contain, is mechanically associated with the iron probably in an oxidised state, than present as a true alloy with the iron itself.

ON THE IMMEDIATE ANALYSIS OF METEORIC IRONS.*

BY STANISLAS MEUNIER,

AIDE NATURALISTE AT THE MUSEUM OF PARIS.

The numerous researches hitherto made with regard to the composition of meteoric irons have demonstrated in these extra-terrestrial bodies the existence of the following compounds:—

1. The general mass which is formed by the union of

* Communicated by the Author.

several alloys in which iron and nickel are predominant, and which we will designate under the name of *nickeliferous iron*. Among the substances comprised in this mass, the *kamacite*, the *taenite*, and the *plessite* will be specially mentioned.

2. The *carburetted iron* comprising the *Campbellite*, and the *Chalypite*, recognisable by the carboniferous deposit which they give under the action of acids.

3. The *sulphuretted iron*, or *troilite*, which appears in nodules and in veins.

4. The *phosphide of iron and nickel*, or *Schreibersite*.

5. The *graphite*.

6. The *external crust*.

7. The *stony particles*, or *crystals*.

8. The *gases* retained by occlusion (Graham).

9. Several compounds which are only met with exceptionally, as *chromite* and *protochloride of iron*.

The last may even have a terrestrial origin, according to the opinion of Mr. Shepard.

I have recently tried to separate those different substances, and I have submitted each of them to a special examination. My results are, for the greatest number, the fixation of their chemical formulæ, and I think they will be received with interest.

I. NICKELIFEROUS IRON.

The first problem to be solved is the separation of the different alloys which are mixed in the general mass of meteoric irons; but it is necessary first of all to prepare that general mass freed from other substances which I have already named.

For this end, the iron being reduced to powder by means of a hard file, the metal is thrown into pure potash fused in a silver crucible. Instantaneously the alkali, hitherto limpid, becomes troubled by the presence of little grey flakes, which are the result of decomposition of troilite, schreibersite, stony matters, &c., and consist of oxide of iron.

When this decomposition of foreign substances is complete, the alkaline mass is cooled and treated by water. All the potash is carried away with the greatest part of oxide of iron. The remainder of this oxide is easily dissolved by strong nitric acid, in which the iron becomes passive.

The metallic powder is then well washed and dried; it is exclusively formed of nickeliferous iron, containing, however, in certain cases, a small proportion of carburetted iron.

Chemical methods have not yet completely succeeded in separating the alloys mixed in the nickeliferous iron, and, after several essays, I have been obliged to employ a physical process.

My experiments have been made with the meteoric irons of Caille (France), and of Charcas (Mexico).

First of all, it was necessary to determine with exactness the number of constituent compounds contained in the nickeliferous iron of those masses. For that purpose a small polished plate of the iron of Caille was heated with precaution and uniformity. This operation, of which the first idea is due to Widmanstätten, drew, by the unequal oxidability of the different immediate principles, a yellow net upon a blue ground. There were also several portions of an intermediate colour, clearly limited like the others, and occupying the spaces bounded by the crossing of the yellow lines.

An attentive examination showed that the metals were reduced to two; the third being

by the mixture of the others, reduced to alternate thin sheets.

The blue iron is formed by the kamacite, and the yellow by the ténite.

Their separation was very difficult on account of the analogy of the chemical properties of the two metals. If it is true that the kamacite is more soluble than the ténite (and this is proved by the experiment of Widmanstätten), it is true also that the difference is too small to permit a separation. When all the kamacite is dissolved, only a very small proportion of the ténite remains; the greatest part being dissolved also.

To effect the separation, I heated some metallic powder placed upon a glass plate. The particles formed by kamacite become blue, whilst the particles of ténite are yellow. Then the two sorts of grains are separated with a pincer.

After about fifteen operations, I collected 2 grammes of kamacite, and 0.5 grammes of ténite, that I could chemically examine.

The Charcas iron gives the same results.

The specific weight of ténite is 7.380. Its analysis has given me the following numbers:—

Iron.....	85.0
Nickel.....	14.0
	—
	99.0

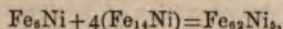
which agree with the formula Fe_8Ni .

The kamacite has a specific weight equal to 7.652, and I have found for its composition—

Iron.....	91.9
Nickel.....	7.0
	—
	98.9

Its formula is Fe_{11}Ni .

On this subject it will be remarked that in admitting, according to the numbers given above, that the Caille iron contains 80 per cent of kamacite and 20 per cent of ténite, its elementary formula will be expressed by



which gives numbers very near those which M. Rivot has obtained in the elementary analysis of that mass.

The above formula gives—

Iron.....	91.4
Nickel.....	8.6
	—
	100.0

And M. Rivot has found, in two analyses—

Iron.....	92.3	92.7
Nickel.....	6.3	5.6
	—	—
	98.6	98.3

All meteoric irons are not so simple as those of Caille and of Charcas. There are some which contain with kamacite and ténite a certain quantity of other metallic alloys.

One of the most important of these is the plessite, which abounds, for example, in irons of Jewell Hill (North Carolina), and of Oldham (Kentucky). I have isolated it by the same method which had served for the preceding substances.

The plessite offers a density of 7.850, and I think that its composition is well represented by the formula Fe_{11}Ni , but I have had so little of this substance that I cannot make a completely satisfactory analysis.

Amongst the other alloys of iron and nickel, I will name the *octibbeite*, whose composition is exceedingly

remarkable for the large proportion of nickel (59.60 per cent). Its density is only equal to 6.854. The meteoric iron of Octibbeha (Mississippi) seems to be entirely formed of that alloy; this results from the studies of Mr. Taylor.

II. CARBURETTED IRON.

Several meteoric irons give, by the action of acid, a black deposit, more or less abundant, consisting of carbon. This carbon comes from a compound of which the composition is analogous to that of steel.

In this point of view, the meteoric iron of Campbell (Tennessee) will be specially mentioned. It gives by analysis a metallic matter, formed by the union of 1.50 per cent of carbon with 97.54 per cent of iron. I propose for it the name of *Campbellite*; its density is 7.05.

Mr. Shepard gives the name of *chalypite* to a carbide of iron of which Forchhammer has noticed the presence in the meteoric iron of Niakornak (Greenland), and of which the formula is CFe_2 . I have had no opportunity of seeing this substance, which does not exist in the Museum of Paris.

III. SULPHURETTED IRON.

To prepare the sulphuretted iron, or *troilite*, in a complete state of purity, we may have recourse to the metallic powder. This powder is placed during a quarter of an hour in a boiling concentrated solution of sulphate of copper. All the nickeliferous iron is dissolved, and, by decanting and washing, a mixture of metallic copper, troilite, schreibersite, graphite, and stony matter is obtained.

A small quantity of concentrated nitric acid dissolves the copper. The magnet, acting under water, is the best means to separate troilite and schreibersite (which are magnetic) from graphite and stony matter. Lixivation, in conclusion, can be employed to isolate troilite from schreibersite.

When the iron under experiment contains only a small quantity of troilite, it is preferable not to make use of nitric acid, which always dissolves a little of the desired substance. In these cases I dissolve the nickeliferous iron by means of bichloride of mercury. The protochloride of mercury is carried off by a solution of chlorine, and it is easy to separate the metallic mercury.

Besides, it is always better, when possible, not to extract troilite, from no matter what part of iron, but from the cylindroid nodules in which the substance has concentrated itself. Thus the sulphuretted iron contains only some graphite and stony matter, which can be got rid of by the action of the magnet. It is correct to say that this troilite is one of the most characteristic principles of meteoric iron. Notwithstanding, its crystalline forms have not yet been recognised, and there is some doubt about its chemical composition.

The first chemists who examined it considered it as a variety of Breithaupt's pyrrhotine, and gave to it the formula Fe_7S_8 .

But Mr. Lawrence Smith concluded from his analysis of the sulphur of the iron of Tazewell, that it has the composition of the protosulphide FeS .

Notwithstanding, he continued to give it the name of pyrrhotine, and thus a great confusion was introduced into science. Besides, Mr. Smith rested both upon the results of his own experiments and upon those obtained by several chemists in the examination of other troilites; his conclusion was not admitted, and the existence of true crystalline magnetic pyrites in meteorites will increase the doubts.

The distinction between the troilite (or Mr. Smith's pyrrhotine) and the Breithaupt's pyrrhotine, is not so clear as it seems at the first view. The difference of composition is very slight, and the physical properties are very similar.

I have had lately occasion to analyse several specimens of troilite taken from the meteoric irons of Charcas and of Toluca (Mexico), and the numbers which I have obtained have given me reason to think that the mineral in question is nearer to magnetic pyrites than to protosulphide of iron.

Before giving the results of my analyses, I will call attention to a reaction which seems to me calculated to permit in all cases to distinguish the protosulphide from the magnetic pyrites, and, *à fortiori*, from compounds which are more rich in sulphur.

When protosulphide of iron is placed in a solution of copper, it precipitates this metal almost like iron itself; pyrrhotine, on the contrary, does not produce such a precipitation. The protosulphide obtained by the action of sulphide of ammonium upon iron salts produced the same effect as the substance of exactly the same composition prepared by igneous means.

This being well established, I put several troilites into a solution of copper, and I did not observe any precipitation; the troilite is then very like the magnetic pyrites in this respect, and we may arrive at the same conclusion relatively to the chemical composition.

In fact Mr. Smith has based his formula, FeS , upon his analysis of Tazewell's troilite, which gave him:—

Iron	62.38
Nickel	0.62
Copper	trace
Lime	0.08
Silica	0.56
Sulphur	35.67

99.31

But these numbers show that the substance employed in his experiments was very impure.

I have begun to purify the troilite by the process described above, and I have thus obtained a matter of which the specific gravity was 4.799. Its colour was bronze, and its analysis gave me:—

Iron	59.01
Nickel	0.14
Copper	trace
Sulphur	40.03

99.18

I will remind the reader that the formula Fe_2S_3 requires—

Iron	60.4
Sulphur	39.6

100.00

The Charcas troilite, previously purified, gave me—

Iron	56.29
Nickel	3.10
Sulphur	39.21

98.60

Its density is equal to 4.78.

The normal presence of nickel makes of troilite a species distinct from pyrrhotine, and its true formula is $(\text{Fe.Ni})_2\text{S}_3$.

IV. SCHREIBERSITE.

I prepare schreibersite, or phosphide of iron and nickel, by the same method as troilite.

Besides, as for the latter, it is always preferable to take the schreibersite in the places where it is naturally concentrated.

It is a metallic matter, yellowish or almost white. Its specific gravity is 7.103, and I have found in the schreibersite of Toluca's iron:—

Iron	57.11
Nickel	28.35
Cobalt	trace
Magnesium	trace
Phosphorus	15.01

100.47

These numbers lead to the formula $\text{Fe}_2\text{Ni}_2\text{P}$, yet admitted by Mr. Smith after the analysis of the Tazewell's schreibersite. My confirmation is the more interesting in that Bergemann, analysing the same substance as I but impure, found—

Iron	87.0
Nickel	9.5
Phosphorus	3.5

100.0

Schreibersite is magnetic, and takes permanent polarity by contact with a magnet. It is brittle. Hydrochloric acid has no action upon it. Crystalline forms have not as yet been observed.

V. GRAPHITE.

Graphite may be isolated by the following method:—A few grammes of metallic powder are projected into fused potash, and thus a mixture of nickeliferous iron and graphite is obtained. This mixture may be treated in several ways.

1st. Iron is dissolved in chlorhydric acid, which leaves as residue the graphite almost pure.

2nd. The graphite is separated by lixiviation. This process presents the advantage of giving both graphite and nickeliferous iron; but the separation is never complete.

3rd, and lastly. The magnet may be employed only when the graphite is abundant; in other cases it is drawn up with the metal.

In all cases the residue is washed by chlorhydric acid to dissolve foreign matters, such as troilite and schreibersite, or what results from their being attacked by fused alkali.

The graphite extracted from the Caille iron shows a density equal to 1.715. Its analysis gave—

Carbon	97.3
Iron	2.4
Nickel	trace

99.7

The graphite of the Charcas iron has a density of 1.309, and this is the result that I have obtained in its analysis:—

Carbon	98.0
Iron	0.9

98.9

The graphite is remarkable on account of its great unalterability.

VI. EXTERNAL CRUST.

The portions of meteoric iron, upon which is the crust, being separated by means of a saw,

placed in a concentrated solution of bichloride of mercury. After a sufficient time all metallic particles are dissolved, and the oxides, amongst which is the crust, remain alone.

However, the crust is still mixed with foreign matters. Usually there is with it the products of its alteration by atmospheric agents, and particularly limonite. Some schreibersite, troilite, and stony grains may be also mixed with the principal substance, and their separation is very difficult.

Weak chlorhydric acid carries away limonite and troilite; stony grains remain as residue after the action of the magnet; lixiviation permits the purification of the crust from schreibersite.

Besides, these operations may be simplified by choosing the portions of the crust that seem almost pure. They frequently detach themselves from the subjacent metallic matter.

Very few chemists have analysed the external crust of meteoric irons. The analyses given by Pugh, as showing the composition of the crust of the Toluca iron, have evidently been executed on an impure mineral. As it is precisely the crust that I have examined myself, I will record Pugh's results:—

Metallic iron.....	18.717
Protoxide of iron.....	19.309
Sesquioxide of iron.....	32.750
Protoxide of nickel and of cobalt.	5.751
Chalk.....	trace
Silicates.....	10.203
Water.....	13.270
Chlorine.....	trace
	100.000

Evidently metallic iron, silicates, and water are not essential elements of the crust, and must be considered as impurities.

Having purified as much as possible by the method above described the crust of Toluca iron, I have found for it a density of 4.89, and the following composition:—

Sesquioxide of iron.....	6.893
Protoxide of iron.....	28.12
Protoxide of nickel.....	2.00
Protoxide of cobalt.....	trace
	99.05

These numbers agree with the formula Fe_3O_4 , $(\text{FeNi})\text{O}$, which does not differ from that of magnetite, except by the substitution of a small portion of nickel for a corresponding quantity of the iron of the protoxide.

It is remarkable that, if in Pugh's analysis we only consider sesquioxide of iron, protoxide of iron, and protoxide of nickel and of cobalt, we arrive at numbers very near to those required by the above formula.

VII. STONY GRAINS.

Several of the operations described above may evidently serve to prepare the stony grains in a state of purity. But this is how the separation must be made when it is especially intended to obtain these grains.

Iron in form of lumps is left protected from the contact of the air in a concentrated solution of bichloride of mercury, and frequently stirred. After a sufficient time the metal disappears, and the liquid contains stony grains mixed with protochloride of mercury,

and generally with a small quantity of metallic mercury. There is also troilite, schreibersite, and graphite. A solution of chlorine carries off the calomel, and the magnet isolates the schreibersite and the troilite; lixiviation may be employed to get rid of graphite.

In certain cases, time can be saved by submitting to the action of a current of hydrogen the magma produced by the action of the bichloride. Heat carries off the calomel, the mercury, the troilite, and the schreibersite. The stony matter is purified from graphite by lixiviation.

If the stony grains (as is the ordinary case) are not oxidisable, hydrogen may even be replaced by air, which burns the carbon and gives directly the stony grains perfectly pure.

These grains are of different composition, and it appears that there exists a certain relation between their composition and their situation. Some are localised in the iron; others are situated in the troilite, or, perhaps, in the graphite which surrounds this sulphur.

The grains of the first category may be found in meteoric irons of Tazewell and of Tucson. They are formed of peridotite, which is proved by the analyses published by Mr. Lawrence Smith. I have studied those grains, and found that their density is equal to 3.35. I have not observed crystalline forms.

The grains of the second category were given by the troilite of the Caille iron. Their quantity was too small for me to be able to analyse them, but I have submitted them to the blowpipe assay. Those grains are not fusible, and gave nothing but the reaction of silica.

The troilite of Charcas iron gave me analogous results.

VIII. GASES.

Gases have been recognised in the meteoric iron of Lenarto, by M. Boussingault and by Mr. Graham.

I have sought the same bodies in another iron of the same origin by means of the solution of those masses in concentrated bichloride of mercury. The results were that gases do not exist in appreciable quantity in the irons of Caille and of Charcas. The mass of Krasnojarsk (Siberia) gave me a small bubble of gas, having the composition of atmospheric air; but it must be remarked that this iron was cracked.

IX. RARE SUBSTANCES.

In concluding this enumeration, I must mention chromite and protochloride of iron, which appear in certain irons. Their separation is evidently easy, and their composition is identical with that of analogous terrestrial compounds.

After having described the methods which have permitted me to separate in a state of complete purity the immediate principles of meteoric irons, I will remark that those methods can be employed to estimate the relative quantity of the substances in question.

I have, for instance, submitted to a quantitative immediate analysis the meteoric iron discovered in 1784, at Xiquipilco, in the valley of Toluca (Mexico), and I have found in it—

Nickeliferous iron.....	96.301
Graphite.....	1.176
Troilite.....	1.482
Schreibersite.....	1.232
	100.191

I will remark upon this subject that those numbers

are exact exclusively for the analysed specimen. In other parts of the same mass, crust, stony matters, &c. may be found, and perhaps some of the above-named principles can disappear.

I will show in another paper how my studies have given me a good rule for the classification of meteoric IRONS.

Paris, November 27th, 1868.

ON THE

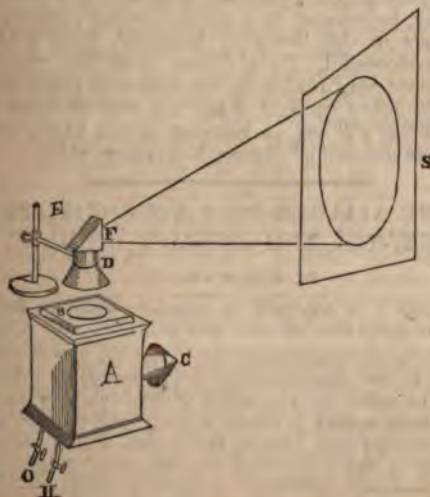
EXHIBITION OF COHESION FIGURES TO A LECTURE AUDIENCE.

BY C. J. WOODWARD, B.SC.,

LECTURER ON CHEMISTRY AND PHYSICS, MIDLAND INSTITUTE, BIRMINGHAM.

WISHING to exhibit the singular figures discovered by Professor Tomlinson, and known as cohesion figures, I proposed adopting the method mentioned by Mr. Reynolds in the *CHEMICAL NEWS* of November 27th (*Am. Repr., Jan. '69, page 46*); but it occurred to me that an arrangement similar to that used to show waves in water would probably serve the purpose. I therefore tried the following plan, which, though not so successful as the one I shall afterwards describe, is well worth trying:—A box with a glass bottom was filled with water and a lime light placed underneath the box. On throwing a spot of liquid, giving a cohesion figure, on to the water, the figure, more or less definite, was exhibited on a tracing paper screen placed above the box. Even with a candle underneath the box the figures were visible, but of course not sharp as when the oxy-hydrogen light was used. This experiment led me to devise the following arrangement, which, with such liquids as I have tried, serves admirably, the figures being projected on to the screen with great clearness:—

In the first place several troughs are made to hold the water on which to place the creosote, &c. Those I have are made of plate glass. A piece of glass 5 inches square and $\frac{1}{4}$ inch thick has a hole 3 inches diameter cut in it, and this, when laid on a plain piece of glass, forms a circular trough, 3 inches diameter and $\frac{1}{4}$ inch deep. An ordinary oxy-hydrogen lantern, from



which the nozzle has been removed, is now tilted back so that the light from the lantern is thrown perpendicularly upward, and the trough placed just over the front of the lantern as though it were a lantern slide. The nozzle of the lantern, fitted to a projecting arm, is then brought over the trough and an image of the upper surface of the water obtained on the ceiling. On now placing a drop of creosote on the water an image of it is seen on the ceiling. If it be desired to throw the image on to a vertical screen, a reflecting prism is placed on the nozzle, by which the desired effect is obtained.

The arrangement will be completely understood by referring to the accompanying figure, in which A is the lantern turned back; C, the chimney; B, the glass trough to hold the water on which the creosote or other liquid is placed; D, nozzle of lantern, supported by the horizontal arm E; F, reflecting prism; S, screen on which the image is received.

It should be mentioned that it is necessary to remove the usual taper pipe of the nozzle of the lantern, and substitute a shorter one, so that the figures may be properly focussed, and yet room enough left to introduce a pipette between the nozzle and the trough containing the water.

NOTE ON

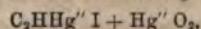
A MERCURY-COMPOUND OF ACETYLENE.

BY H. BASSETT.

ON passing a stream of coal-gas through the solution known as Nessler's ammonia-test, i.e., a solution of mercuric iodide in iodide of potassium and caustic potash, a considerable quantity of a bright yellow precipitate is obtained. This precipitate is only formed in presence of free potash. After drying, it explodes slightly on heating, giving a sublimate of mercury and iodide of mercury, and leaving a carbonaceous residue. On warming with dilute hydrochloric acid, an inflammable gas is given off, having the characteristic smell of acetylene, and giving, with ammoniacal cuprous chloride, the well-known red precipitate.

The experiment was modified as follows:—A large Bunsen burner was lighted at the bottom, and the supply of air partly cut off; the products of combustion were drawn by an aspirator through a washing-bottle of water, and then through the mercurial solution. This method gave a precipitate of a pale yellowish colour, which exploded rather more violently than the above, resembling in appearance that which was found to be produced by pure acetylene (from the copper compound).

On analysis, this substance gave 70.24 per cent mercury and 23.5 per cent iodine. These numbers may be considered to indicate sufficiently the formula—



which requires 70.42 and 23.36 respectively.

The different appearance of the precipitate produced by coal-gas appears to be owing to the presence of other hydrocarbons. In fact, crude benzene gave a bright yellow precipitate, as also did purified oil of turpentine. No precipitate was produced by ethylene or pure benzene. In the case of turpentine, the action seems to consist in a reduction of the mercuric salts with formation of mercurous-mercuric iodide, of — the precipitate is mainly composed with — of organic matter.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

No. II.*

BY J. N. LOCKYER.

THE author, after referring to his ineffectual attempts since 1866 to observe the spectrum of the prominences with an instrument of small dispersive powers, gave an account of the delays which had impeded the construction of a larger one (the funds for which were supplied by the Government-Grant Committee early in 1867), in order that the coincidence in time between his results and those obtained by the Indian observers might not be misinterpreted.

Details are given of the observations made by the new instrument, which was received incomplete on the 16th of October. These observations include the discovery and exact determination of the lines of the prominence spectrum on the 20th of October, and of the fact that the prominences are merely local aggregations of a medium which entirely envelopes the sun. The term chromosphere is suggested for this envelope, in order to distinguish it from the cool absorbing atmosphere on the one hand, and from the white light-giving photosphere on the other. The possibility of variations in the thickness of this envelope is suggested, and the phenomena presented by the star in Corona are referred to.

It is stated that, under proper instrumental and atmospheric conditions, the spectrum of the chromosphere is always visible in every part of the sun's periphery; its height, and the dimensions and shapes of several prominences, observed at different times, are given in the paper. One prominence, 3' high, was observed on the 20th of October.

Two of the lines correspond with Fraunhofer's c and f; another lies 8° or 9° (of Kirchhoff's scale) from d towards e. There is another bright line, which occasionally makes its appearance near c, but slightly less refrangible than that line. It is remarked that the line near d has no corresponding line ordinarily visible in the solar spectrum. The author has been led by his observations to ascribe great variation of brilliancy to the lines. On the 5th of November, a prominence was observed in which the action was evidently very intense; and on this occasion the light and colour of the line at f were most vivid. This was not observed all along the line visible in the field of view of the instrument, but only at certain parts of the line which appeared to widen out.

The author points out that the line f invariably expands (that the band of light gets wider and wider) as the sun is approached, and that the c line and the d line do not; and he enlarges upon the importance of this fact, taken in connection with the researches of Plücker, Hittorf, and Frankland on the spectrum of hydrogen—stating at the same time that he is engaged in researches on gaseous spectra which, it is possible, will enable us to determine the temperature and pressure at the surfaces of the chromosphere, and to give a full explanation of the various colours of the prominences which have been observed at different times.

The paper also refers to certain bright regions in the solar spectrum itself.

Evidence is adduced to show that possibly a chromosphere is, under certain conditions, a regular part of star-economy, and the outburst of the star in Corona is especially dwelt upon.

* Abstract from the *Proceedings of the Royal Society*, No. 106, 1868.

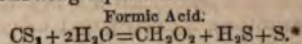
ON THE ACTION OF SUNLIGHT ON BISULPHIDE OF CARBON.

BY O. LOEW,

CHEMICAL ASSISTANT IN THE COLLEGE OF THE CITY OF NEW YORK.

PURE bisulphide of carbon, when exposed to the sunlight for a considerable time, becomes somewhat yellow. To study the changes thus produced, a large quantity of the bisulphide was enclosed in sealed tubes and exposed to the action of the sun. Decomposition took place gradually, and a brown insoluble substance was formed, which adhered so closely to the inner surface of the tubes that it could not be detached by vigorous shaking. This substance prevented the further action of the sun's rays, and consequently the decomposition ceased.

If water be present in the tubes, this adherence is prevented, and a larger quantity of the brown substance is obtained. After an exposure of two or three months the tubes were opened. The water was slightly acid in its reaction, and, after being neutralised and concentrated, it showed a distinct reducing power upon salts of silver and mercury. Evidently, therefore, a trace of formic acid was produced, according to the following equation:—



On filtration, the newly-formed brown compound remained on the filter, while the filtrate contained free sulphur dissolved in the bisulphide of carbon. On examination, this compound corresponded in every particular to the sesquisulphide of carbon, the substance discovered by me two years ago. It was insoluble in water, alcohol, ether, chloroform, bisulphide of carbon, and oils, but soluble with decomposition in a boiling solution of caustic potash. On heating it in a glass tube, it was directly separated into its components; the sulphur volatilised and the carbon remained.

If sulphocarbonate of potash in concentrated solution be exposed to the sunlight, the decomposition is so slight as hardly to be noticed; when the solution is treated with sodium amalgam, however, a reduction to lower sulphides takes place.

In view of the fact that direct sunlight reduces free bisulphide of carbon, it might be supposed that the corresponding body, carbonic acid, would, in presence of water, be reduced in a similar manner; all my experiments in this direction, however, have thus far been unsuccessful. Nevertheless, since this reduction takes place very readily in the tissues of plants under the influence of sunlight, I am not without hope that this process will yet be imitated in the laboratory.—*American Journal of Science*, November, 1868.

ON THE ALLEGED POISONOUS QUALITY OF BEEF-TEA AND EXTRACT OF MEAT.

BY BARON LIEBIG.

ALTHOUGH it is contrary to common sense to believe that the daily food of men and animals could possibly contain a substance injurious to health, it was nevertheless to be expected that the experiments made by Dr. Kemmerich on the effect of beef-tea and its salts on animals would produce anxiety and fear in some weak minds; and, indeed, the article which appeared in *Once a Week*, entitled, "A Word of Warning to

* C = 12; O = 16; S = 32, &c.

Cooks," is a proof that such fears really existed. I believe, however, that a simple acquaintance with the experiments of Dr. Kemmerich will be sufficient to dispel them completely. The results of these experiments are of a very harmless character. Dr. Kemmerich made most of his experiments, not upon men, but upon graminivorous animals, viz., upon rabbits, and only one experiment was made by him upon a dog. The broth was made from horseflesh, and injected into the stomach of the animals in progressively augmented quantities, the chief results of which are as follows:—

A rabbit weighing not quite two pounds, which had received the broth from one pound of horseflesh (equivalent to half an ounce of extract), remained perfectly well. It polished itself with its paws, was very lively, and no disturbance in the state of its health was afterwards perceptible.

A second rabbit of two pounds weight, into the stomach of which the extract of one pound and a quarter of horseflesh had been introduced, departed itself in just the same manner; its pulse became more vigorous, its breathing slower, and it remained lively and healthy.

When, however, the doses were increased, and the extract of two pounds and of two pounds and a quarter of flesh were injected into the stomach of the rabbit, such quantities of concentrated animal food were evidently too much for the little graminivorous creature, which by such doses Dr. Kemmerich succeeded in killing, a result at which nobody will be surprised. It follows that Dr. Kemmerich could likewise have killed stronger animals with beef-tea; and it may be assumed that he would have killed even a man of 140 lbs. weight (seventy times heavier than a rabbit) by a dose of beef-tea seventy times as large,—namely, by the broth of 140 lbs. of flesh, equivalent to about 4 lbs. of extract of meat. Less than a couple of pounds of extract would, however, scarcely have been sufficient, for one of the experiments of Dr. Kemmerich on a carnivorous animal contrasted with the experiments on the rabbits; he did not succeed in poisoning that animal with beef-tea.

It was a small but very strong terrier which had taken the broth of four pounds of flesh (equivalent to two ounces of extract), which the animal seemed to enjoy considerably. As, however, the whole quantity was too much for it, it became necessary to inject the remainder into its stomach. Notwithstanding the enormous quantity of extract of meat which had been introduced by force, the terrier remained very comfortable and lively, and no symptom of any disturbance of its health became manifest. Double the quantity of meat-broth which killed the rabbit had not the least injurious effect on the little dog.

These experiments and the above calculations show sufficiently what is to be thought of the poisonous effect of beef-tea; it belongs to the category of cases where people have eaten *pâté de foie gras*, turtle soup, or oysters to such excess as to cause death; but no sensible person will ever dream of ascribing, on that ground, poisonous qualities to *pâté de foie gras*, turtle soup, or oysters.

The experiments of Dr. Kemmerich are described in his "Dissertatio Inauguralis," for obtaining the degree of Doctor from the medical faculty at Bonn; and in his connecting with his conclusions the meaning of the word "poison" he, in fact, succeeded in drawing to his work the attention of the public, which otherwise would probably have taken little notice of it.

Dr. Kemmerich ascribes the effect of beef-tea not to its aromatic and combustible ingredients, but to the potash salts which it contains, and of which it is well known that in larger doses they exercise an injurious effect on the organism; nevertheless, and this is a matter of great importance, potash salts are an element of all articles of food; they not only form the chief ingredients of the salts of all sorts of flesh, including the flesh of fish, but likewise of all other food, and of all the food of animals. The alkaline salts of bread, vegetables, and hay consist of potash salts, and, with the exception of chloride of sodium (kitchen salt), soda salts are but rarely contained therein; in fact, it may safely be asserted that without the potash salts our food would be quite unfit for nourishment.

It does not follow, therefore, that these salts, when taken in excess, like any other—even the most harmless substance—might not eventually exercise an injurious effect. It is, however, preposterous to apply the meaning which we are accustomed to attach to the word "poison" to the effects of such an excess. It is surely quite absurd to connect this meaning with substances which we daily take in our food, and which are quite indispensable to our existence.

Dr. Kemmerich himself says (p. 31), "I do not think of the possibility that beef-tea, in the form in which it is used for household purposes, could be the cause of poisoning; it therefore does not require a medical warning to protect from poisoning with Liebig's extract of meat." He further says, "In medical practice, wine, ether, camphor and musk are eminent analeptica (invigorating and refreshing remedies). Compared to these giants of medicine beef-tea modestly occupies a subordinate position. If, however, it be necessary to preserve the exhausted body from protracted illness, then there is no other remedy in the whole rich store of medicine which can afford such assistance for regenerating the diseased organism as repeated doses of beef-tea."

One of the three theses defended by Dr. Kemmerich, on his promotion before the medical faculty at Bonn, is worthy of observation by the British navy. It runs thus:—

Thesis 2. "The best remedy against scurvy is beef-tea, or Liebig's extract of meat."—*Pharmaceutical Journal*.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from Am. Repr. Feb. '69, page 76.)

Preservation of Food—Unwholesome and Adulterated Food.

I COME now to the last division of our subject—viz., that which relates to the sale and use of unsound and adulterated food; and perhaps the most important of this kind of food is bad meat—that is, meat which is unwholesome on account of putridity or disease. Food of this description has always been a subject of legal prohibition. Among the Jews the prohibition dates from the time of Moses, who is supposed to have received from the Lord, during his sojourn upon Mount Sinai, certain oral commandments respecting the slaughtering of animals for food and the examination of their bodies for disease. There is no account of these commandments in the written law, but they were evidently communicated to the

* The Cantor Lectures delivered by

Moses, for he says, "Thou shalt kill of thy herd, and of thy flock, which the Lord hath given thee, as I have commanded thee."—(Deut., chap. xii., v. 21.) It is presumed, therefore, that these instructions were very specific, and they have been practised by the Jews from that time until now. The Hebrew law is, that no flesh shall be eaten, except of animals that have been killed and searched, or examined, by the officer (*bodek*) appointed for that purpose; and the most precise rules are laid down for his guidance in these matters. In fact he is bound by very solemn obligations to declare of every animal that he kills whether the flesh is proper to be eaten (*caser*), or is unfit for food, by reason of its being diseased or torn (*trefa*). This expression appears to have been derived from an ordinance of Moses, that no flesh should be eaten that is torn in the field (Exodus, chap. xxii., v. 31); the word torn (*trefa* or *terefa*) being supposed, according to the traditions of Hebrew sages, to apply not only to animals torn in the chase, or by wild beasts, or by the bungling act of the butcher, but also to those affected with any disease that would shorten their lives; and as it is thought that such disease is always indicated by the condition of the lungs, the utmost care is taken by the searcher or *bodek* in the examination of these organs. His rules or instructions for this purpose are very strict; but generally it may be said that he condemns as unlawful, or unfit for food, the flesh of all animals in which the lungs present the following appearances:—Certain deficiencies, excess, or displacement of the lobes; adhesions, or false membranes; tubercles, or abscesses containing matter or opaque water; discolourations which do not disappear when the lungs are inflated; ulcers, holes, and abrasions letting air through them; consolidations that are impervious to air, and rottenness of tissue. Many of these are, no doubt, unimportant evidences of disease, and, therefore, although the flesh of such animals is rejected by the Jew, it is freely consumed by the Christian. The Jews, indeed, make a sort of bargain with the unorthodox butcher, to take only such animals, when slaughtered by their officer, the *bodek*, as he considers lawful, and the rest are sold to the public. I dare say this has been the practice at all times, for there are frequent references to it in our legal and domestic records. In *Liber albus*, for example, there is a memorandum to the effect that on the 24th of June, 1274, certain discreet men of the city were summoned before the king's council, to answer the question as to what was done with the unclean flesh of the Jews, and whether it was lawful for Christians to buy and eat the same. Their answer was, that if any citizen bought such flesh of a Jew, he would be expelled, and if convicted by the sheriff he would forfeit such flesh, which would be given to lepers or dogs, and he, in addition, would be heavily fined. To which the council replied that they commanded them, in the king's name, to have the custom strictly observed. I fear, however, from the legal records of *Liber albus*, that less attention was paid in those days to the sale of diseased meat than to that of putrid meat; for, on examining the accounts of the citizens made and rendered in divers courts of the king, I find that while "judgment of pillory" is recorded in twenty-one cases for selling putrid meat, poultry, or fish, there is not a single instance of a like punishment for selling the unclean meat of the Jews.

In ancient Rome there were overseers appointed to examine the meat in the public markets before it was sold, and butchers were often fined for neglecting the

law in this respect. Mr. Charles Reed has given us an example of this from the *Acta Diurna*, or Roman Gazette, of 585 years after the building of Rome, which, when translated, runs thus: A.U.C. DLXXXV., Fourth of the kalends of April. The fasces, with Licinius, the consul, and Lertinus, ædile, fined the butchers for selling meat which had not been inspected by the overseers of the markets. The fine is to be employed towards building a chapel to the temple of the goddess Tellus.

In modern times, also, severe regulations have been made in all the states of Europe for the government of this matter, and in many cases particular instructions are given as to the kind of disease which renders meat unfit for human food—it being the practice to examine the animal while alive, and its carcass when dead. This examination is entrusted to properly-qualified officers, who are bound to condemn diseased and putrid meat, as well as the flesh of animals that have died otherwise than by the hand of the butcher, and no meat can be sold until it has undergone such an examination. In this country, however, although there are laws prohibiting the sale of unsound and unwholesome food, yet there is no provision for the systematic inspection of meat, even when it has reached the public shambles. All that the law declares is that the local authority may, if it pleases, appoint an officer for that purpose; and as the appointment would cost money, and is not compulsory, it is rarely made. Practically, therefore, there is, except in a few places, an almost unchecked traffic in diseased and unwholesome meat, and the worst descriptions of it are generally sold to the poor at night.

Our forefathers made stringent rules to prevent this; for, among other things, they ordained "that butchers shall close their shops before candle-light, and shall not sell flesh meat by light of candle."—(*Liber albus*.)

Within the City of London the inspection is performed as carefully as it can be, but, nevertheless, amidst the confusion of business in the early hours of morning, a great deal of unsound meat escapes the notice of the inspectors. In fact, if it were not for the assistance afforded to them by the salesmen of the markets, it would be absolutely impossible to check, to any large extent, the sale of unwholesome meat; for in the three markets of the city—Newgate, Aldgate, and Leadenhall, as much as 400 tons of meat are sold daily. It is brought from all parts of Great Britain and Ireland, as well as from Belgium, Holland, and France, and even from the ports of the Baltic. Of this a large quantity is diseased, and it comes chiefly from our own country towns, where it is a common practice to forward to London everything that is unsaleable at home. I cannot tell what is the actual proportion of bad meat to good, but we seize and condemn about two tons a week, and this is in the proportion of one part to 750. Last year the amount of meat condemned as unfit for food was nearly 129 tons. And in the preceding year it was more than 152 tons. In fact, during the seven years which have expired since the inspectors were appointed under my recommendation, we have seized and destroyed 1,567,810 lbs., or just 700 tons of meat as unfit for human food. Of this quantity, 805,653 lbs. were diseased, 568,375 lbs. were putrid, and 193,782 lbs. were from animals that had not been slaughtered, but had died from accident or disease. It consisted of 6,640 sheep and lambs, 1,025 calves, 2,896 pigs, 9,104 quarters of beef, and 21,976 joints of meat; besides which there were also seized and condemned in the city markets, on account of putridity, 19,040 head

of game and poultry, 207 quarters of venison, and above 7,000,000 of fish, together with thousands of bushels of whelks, shrimps, periwinkles, &c.

It is to be regretted that in the various Acts of Parliament which relate to the condemnation of unsound meat, there are no special rules for the guidance of the officers appointed to investigate this matter—there being only a very loosely-worded general provision to the effect that the medical officer of health, or the inspector of slaughter-houses, or the inspector of nuisances, may, at all reasonable times, inspect and examine any animal, carcass, meat, poultry, game, flesh, fish, &c., exposed for sale, or deposited in any place for the purpose of sale, or in preparation for sale, or intended for the food of man; and in case it appears to the medical officer of health, or the inspector, to be diseased, or unsound, or unwholesome, or unfit for the food of man, it shall be lawful for him to seize the same, and for a justice to order it to be destroyed. In this regulation there is no particular reference to the kind of food which is unwholesome, or to the circumstances which render it so, and therefore much is left to the discretion of the officer who examines it. In the city of London the practice is to condemn the flesh of animals infected with certain parasites, as measles, flukes, &c.; and of animals suffering from fever or acute inflammatory affections, as rinderpest, pleuro-pneumonia, and the fever of parturition, and of animals emaciated by lingering disease, and those which have died from accident or from natural causes, as well as all meat tainted with physis, or in a high state of putrefaction. A little practice is required to distinguish meat of this description, but generally it may be said that good meat has the following characters:

1st. It is neither of a pale pink color nor of a deep purple tint, for the former is a sign of disease, and the latter indicates that the animal has not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

2nd. It has a marbled appearance from the ramifications of little veins of fat among the muscles.

3d. It should be firm and elastic to the touch, and should scarcely moisten the fingers—bad meat being wet, and sodden, and flabby, with the fat looking like jelly or wet parchment.

4th. It should have little or no odour, and the odour should not be disagreeable, for diseased meat has a sickly cadaverous smell, and sometimes a smell of physis. This is very discoverable when the meat is chopped up and drenched with warm water.

5th. It should not shrink or waste much in cooking.

6th. It should not run to water or become very wet on standing for a day or so, but should, on the contrary, dry upon the surface.

7th. When betried at a temperature of 212° or thereabout, it should not lose more than from 70 to 74 per cent of its weight, whereas bad meat will often lose as much as 80 per cent.

Other properties of a more refined character will also serve for the recognition of bad meat, as that the juice of the flesh is alkaline or neutral to test-paper, instead of being distinctly acid; and the muscular fibre, when examined under the microscope, is found to be sodden and ill-defined.

The signs of parasitic diseases are not always observable without careful examination. In the case of the fluke in the livers of sheep, and of measles in pork, and of hydatids in the brain or liver, the nature of the

disease is at once discoverable, but it is not so with the smaller measles or *cysticerci* of beef and veal, and it is still less so with the *trichina* of pork—the microscope being required to reveal their presence.

And here, perhaps, we may ask, what are the effects of diseased or putrid meat on the human system? The question is undoubtedly very difficult to answer, for while, on the one hand, we have abundant evidence that such meat may be eaten with impunity, so on the other we have many remarkable instances of injury occasioned by it. In Scotland there is a disease called braxy, which attacks the sheep and lambs in spring and early summer. It is the cause of at least half the deaths in the flock during the year. The disease kills the animal very quickly by causing stagnation of blood in the most important vital organs; and as the carcass is the perquisite of the herdsman, he most invariably eats it—taking the precaution to remove the offal, and to cut away the darker portions of the flesh where the blood has stagnated. He also salts it before he uses it; and if questioned on the subject he will tell you that the meat is not unwholesome. Every now and then, however, when perhaps the diseased parts have not been entirely removed, or when the salting has not been sufficiently prolonged, or the cooking has not been thoroughly effected, the most serious consequences result from it, inasmuch that many medical practitioners who are acquainted with the habits of the Scotch shepherds in this respect, and have seen the mischief occasioned by the meat, declare that braxy mutton is a highly dangerous food for man. Again, it is a common practice with farm-labourers to eat the flesh of sheep affected with staggers, which is a parasitic disease of the brain; and even of animals dying from acute inflammatory diseases. There is a story told on the authority of Dr. Brücke, the professor of physiology in Vienna, that some years ago, when the steppe-murrain was prevalent in Bohemia, and the infected animals were killed and buried by order of the government, the poor people dug up the carcasses of the dead bullocks, and cooked them, and ate them without injury. In this country also, during the prevalence of rinderpest in 1863, enormous quantities of meat from the diseased animals were sent to market, and sold and eaten. The same has been the case with the carcasses of animals suffering acute pleuro-pneumonia; and if, as Professor Gamgee says, the practice of making salvage out of diseased animals is so common that at least one-fifth of the meat which is sold in the public markets is diseased, we may well ask, in the words of Mr. Simon, how it is that some sort of pestilence is not bearing witness to the fact? How is it that cattle having all the foulness of fever in their blood, or having local sores and infiltrations, that yield one of the deadliest of inoculable morbid poisons, or having their flesh thronged with larval parasites, do not, when slaughtered and eaten, produce a general poisoning? Parent Du Chatelet has commented in very forcible language on the apparent immunity from disease even when the most foul and leathsome of animal foods are eaten. But is it not possible that the danger is averted by the operation of cooking? Not that the human stomach has not also a wonderful protective power in its own natural functions; for the deadly poison of the cobra or the rattlesnake may be swallowed with impunity. It is possible, however, that these safeguards may fail us occasionally, and then it is perhaps that the most serious consequences arise. I have often had to investigate cases of mysterious

disease which had undoubtedly been caused by unsound meat. One of these, of more than ordinary interest, occurred in the month of November, 1860. The history of it is this:—A fore-quarter of cow-beef was purchased in Newgate market by a sausage-maker who lived at Kingsland, and who immediately converted it into sausage meat. Sixty-six persons were known to have eaten of that meat, and sixty-four of them were attacked with sickness, diarrhoea, and great prostration of vital powers. One of them died; and at the request of the coroner, I made a searching inquiry into the matter, and I ascertained that the meat was diseased, and that it, and it alone, had been the cause of all the mischief. Dr. Livingstone tells us that when the flesh of animals affected with pleuro-pneumonia is eaten in South Africa, by either natives or Europeans, it invariably produces malignant carbuncle. He says, indeed, that the effects of the poison were often experienced by the missionaries who had eaten the meat, even when the presence of the disease was scarcely perceptible; and in many cases when the Backwains persisted in devouring the flesh of such diseased animals, death was the consequence. The virus, he says, is neither destroyed by boiling nor by roasting, and of this fact he had innumerable instances. Now, it is a remarkable circumstance that ever since the importation of this disease (pleuro-pneumonia) into England from Holland in 1842, the annual number of deaths from carbuncle, phlegmon, and boils, has been gradually increasing. In the five years preceding that time the mortality in England from carbuncle was scarcely 1 in 10,000 of the deaths; from 1842 to 1846 there is no record of the disease; but in the next five years, from 1846 to 1851, the mortality rose to 2.6 per 10,000 of the deaths; and in the next five years it amounted to 6.2 per 10,000; and in the succeeding five years to 5.4. In the case of phlegmons, the increase in the mortality is still more remarkable, for it rose from an average of 2.5 per 10,000 of the deaths in the five years preceding the importation of the disease, to 81 per 10,000 in the ten years from 1847 to 1856. The Registrar-General of Scotland has directed public attention to this fact, saying that deaths from carbuncle are on the increase, and that the mortality from it has been getting larger and larger ever since the lung disease of cattle was imported into Scotland. This accords with the experience of medical practice; but as it is very difficult to trace the immediate connection of bad food with subsequent disease, there being so many circumstances to weaken the connection, it is not surprising that differences of opinion should exist as to the morbid effects of unsound meat; nothing, in short, but an experimental inquiry into the subject, as has already been done in Germany in the case of parasitic diseases, will bring the question to rest; and I see no reason why such an investigation should not be made on the persons of those who send diseased meat to the public market for sale; for as the common defence of their conduct is, that the meat is good for food, they cannot surely object to the penalty of being made to eat it. Here, for example, is a specimen of pork covered with pustules of small-pox; it was seized by one of the city officers on the road to a notorious sausage-maker, and it may, notwithstanding its disgusting appearance, be good and wholesome food; then why not put the question to the proof by making the vendor of it eat it? In the year 1862, when small-pox was prevalent among the sheep in several parts of England, it was a common practice to send the carcasses of diseased animals to the

London markets for sale as human food. Later still, in 1863, there was an epidemic of what seemed to be scarlet fever among the pigs of this metropolis, and their carcasses, with all the bright crimson look of the disease, were invariably sent to market for sale as food. Since then the London pigs have been the subject of a virulent spotted fever, of the nature of typhus, and these also have been killed in the last stage of the disease, and sold for food. Abundant illustrations of this kind are constantly coming under my notice, and I feel that the question of the fitness of such meat for food is in such an unsettled state that my action in the matter is often very uncertain, and I should like to have the question experimentally determined; for, as it now stands, we are either condemning large quantities of meat which may be eaten with safety, and are, therefore, confiscating property, and lessening the supply of food, or we are permitting unwholesome meat to pass almost unchallenged in the public markets.

(To be continued).

FORMATION OF AN ARTIFICIAL SPECTRUM WITH A FRAUNHOFER LINE.

BY A. WALLNER.

If, by means of a Holtz machine, at a short distance, the rapid discharges of a Leyden jar of about 30 square centimes are passed into an ordinary Geissler tube, and if the tube is placed before the slit of a spectroscope, the spectrum of the gas which fills the tube is first seen. If the length of the discharge is increased a little, the sodium line immediately appears as in the case of induction currents, by heating the capillary part of the tube placed before the slit. With a proper length of spark the brilliancy of the sodium line far exceeds that of the spectrum of the gas. By further increasing the distance of the discharge, the calcium line is produced with such intensity that it cannot be seen to greater advantage by any way hitherto known. Finally, if the length of the spark is again augmented, the phenomenon changes, the light in the tube assumes a dazzling splendour, this luminous line forms a continuous brilliant spectrum in which the spectroscope reveals a completely black line instead of the sodium line; this, therefore, is a Fraunhofer line. If the tube is attentively examined after this experiment, one can connect the phenomenon with the explanation which M. Kirchhoff has given of the spectrum rays. The inner surface of the capillary tube is thickly corroded in consequence of the particles of glass taken away by each discharge, so that by prolonging the experiment, the glass may be completely roughened. These particles immediately raised to incandescence by the discharge, give the sodium line; but soon the tube is filled with sodium vapours, which then absorb the light proceeding from the solid incandescent particles; these form a kind of solid incandescent nucleus surrounded by an atmosphere of vapour.

—*Ann. de Pogg.*, cxxxv.

ON AN OXALATE OF MANGANESE.

BY PROF. HOW, D.C.L.,
WINDSOR, NOVA SCOTIA.

HAVING, in the course of some experiments on manganese, of which an account may soon appear, observed the formation of an oxalate of the metal, which does not seem to have been accurately analysed, I offer the following notice of the salt. The only analytical detail

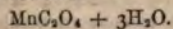
I have been able to find on the subject is in Gerhardt's "Traité de Chimie Organique," vol. i, p. 254, where this statement occurs:—"Oxalates de Manganèse.—Lorsqu'on fait dissoudre le carbonate manganéux dans l'acide oxalique, il se dépose dans la liqueur une poudre blanche, légèrement rosée et cristalline, presque insoluble dans l'eau. Elle paraît contenir 5 atomes d'eau de cristallisation." I think, for reasons now to be given, that the composition of the salt is not as it is thus said to appear. The subject of my communication was formed by precipitation.

When a strong solution of oxalic acid is added to one of sulphate of manganese, in the cold, an almost immediate precipitate of colourless needles begins to form, which become more abundant on standing. When neutral oxalate of ammonium is added to excess of sulphate of manganese and the mixture is briskly stirred, a copious white powdery deposit results, which is seen under the microscope to consist of minute needles. Almost the whole precipitate falls in a few minutes, and when it is deposited no oxalic acid can be detected in the solution by salts of calcium. The crystalline deposits from such acid and neutral fluids consist of the same oxalate of manganese; the salt has a pale rose tint when collected.

In the following analyses the water was determined at 212°, the manganese by ignition. The accurate estimation of the oxalic acid was not attained, because the salt is insoluble in acetic acid and is decomposed by ammonia, apparently with formation, according to Gerhardt, of a double oxalate of ammonium and manganos-ammonium. In the two attempts made, one by adding to the salt first acetic acid, then excess of NH_3 , filtration from a small flocky precipitate, and subsequent addition of CaCl_2 and acetic acid, the other by solution of the salt in dilute HCl , and consecutive addition of chloride of calcium and acetate of potassium, the oxalate of calcium formed contained manganese. The salt was analysed in the air dry state; the result under 1. was from a deposit from the neutral, the other numbers were from the crystals formed in the acid fluid described:—

	Calc.	Found.		
		I.	II.	III.
MnO	= 71 — 36.04	36.90	35.97	37.10
C_2O_3	= 72 — 36.55			
$3\text{H}_2\text{O}$	= 54 — 27.41			26.72
	197 100.00	100.00	100.00	100.00

The experimental percentages obviously agree with those calculated, hence the composition of the salt is shown by the expression:—



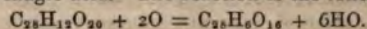
As regards the statement of Gerhardt above given, which refers to a salt resembling that now described, doubtless the same, I find the theoretical percentage belonging to the formula assigned to the salt, which is, in the notation of the period, $2(\text{C}_2\text{O}_3, \text{MnO}) + 5 \text{aq.}$, is 23.93, and I think the loss at 212° must have agreed with this, while a prolonged heating at that temperature would have brought the amount up to that given above. I say this because I have found that the salt of different preparations gives off the first quantities of water with unequal facility, and sometimes loses the rest so slowly that if weighed at short intervals it may be considered dry when it is not so. In my examination I thought I had at least two or three definite hydrates at 212°, but found eventually that all the wa-

ter is really expelled at this temperature. The salt is efflorescent to a certain extent, and hence generally gives too little H_2O and too much MnO on analysis. It has a neutral reaction, and does not dissolve in boiling water. It is curious to find this salt forming in presence of free sulphuric acid. I believe it not to be the only oxalate of manganese, for I have observed the formation of transparent granules, either globular or polyhedral with very small faces, among the needles in the neutral fluid, mentioned above, left standing. The oxalate analysed dissolves only partially in solution of oxalic acid on boiling.

FORMATION OF ELLAGIC ACID BY MEANS OF GALLIC ACID.

BY M. J. LÖWE.

By heating nearly to the boiling point for several hours in an aqueous solution of two equivalents of gallic acid and one of arsenic acid, a crystalline precipitate is deposited, which is none other than ellagic acid; the best way is to mix the two acids in the proportion indicated above, add water, evaporate to dryness, heat in an air bath to 120°, and extract with alcohol at 90°, which does not dissolve ellagic acid. The reaction is the following:—



In commercial tannin there is always gallic acid, and consequently ellagic acid which proceeds from it. A cold extract of oak bark gives by degrees a yellow deposit of ellagic acid, and it is, indeed, this same acid which constitutes that gelatinous covering which is formed over tanned hides.—*Journ. de Chim. Prat.*

ON THE

IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.*

BY W. R. HUTTON, ESQ.

It is a well-known fact that many commercial products at certain temperatures give off an inflammable vapour, and my object in bringing this paper before the Chemical Section is to give the results of comparative trials of the igniting points of a few of the leading articles of commerce, and also to explain the method employed by me in testing, which is very simple and sufficiently accurate.

In commerce there are several substances which, at the ordinary temperature of the atmosphere, are sufficiently volatile to emit enough vapour to form, with atmospheric air, an explosive mixture. There are many others which do not volatilise at quite so low a temperature, but which in a warm room, or exposed to the sun's rays, do give off vapours sufficient to render them dangerous; and there are others, again, that require to be considerably raised in temperature ere vapour is evolved, and, in consequence, may be considered sufficiently safe where ordinary care is employed.

I wish it to be distinctly understood that it is the vapour evolved from ordinary commercial substances, and not the point at which the substance itself will ignite, that my results refer to. To illustrate the difference in the igniting point of the vapours evolved from different articles of commerce, I pour into one glass a small quantity of sulphuric ether, and into another glass the

* Read before the Chemical Section of the Glasgow Philosophical Society, Dec. 21st, 1868.

same volume of ordinary paraffin oil. The one substance—ether—is known to be very volatile, and on bringing a light to within half an inch of its surface an explosion takes place; the other—paraffin oil—is found not to be explosive at the temperature of this room, as it requires a higher temperature to evolve vapour before an explosion will take place.

In the subjoined table, shewing the results of experiments made by me, the samples having been purchased in the usual way, I give the specific gravity of the different commercial products, and the temperature at which their vapour explodes when a lighted taper is kept at $1\frac{1}{2}$ inches from the surface; and also the temperature at which the vapour explodes when the lighted taper is kept at only half an inch from the surface:—

IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.

	Specific Gravity.		Taper $1\frac{1}{2}$ inches from Liquid. ° F.	Taper $\frac{1}{2}$ inch from Liquid. ° F.
Sulphuric ether.....	747	under	53	—
Bisulphide of carbon.....	1270	—	53	—
Petroleum spirit.....	706	—	53	—
Paraffin spirit.....	751	—	70	68
Benzole, 90 per cent.....	861	—	74	71
Crude paraffin oil.....	849	—	74	72
Ditto naphtha.....	884	—	78	74
Brandy.....	940	—	—	85
Wood naphtha.....	840	—	88	81
Crude paraffin oil.....	891	—	89	84
Ditto naphtha.....	881	—	90	86
Holland gin.....	930	—	—	90
Rum.....	936	—	—	90
Methylated spirit.....	827	—	97	86
Burning coal naphtha.....	859	—	100	91
Spirit of wine.....	817	—	104	73
Whisky, 25 O.P.....	893	—	109	83
Ditto 11 O.P.....	905	—	110	84
Petroleum oil.....	801	—	118	110
Light pitch oil.....	920	—	119	109
Resin spirit.....	922	—	122	106
Turpentine.....	875	—	130	119
Sherry wine.....	993	—	—	130
Port wine.....	1003	—	—	130
Refined paraffin oil.....	809	—	134	123
Ditto.....	814	—	138	127
Fusel oil.....	850	—	140	129
Resin oil.....	987	over	212	—
Heavy pitch oil.....	950	—	212	—

It will be observed that the specific gravity bears no relation to the temperature required to expel vapour from many of the products mentioned in the table, and this, in some instances, arises from the fact that they are not isolated chemical substances, but consist of distinct compound bodies mixed together, the lighter of which usually, but not always, distils off first. This is very well shown from the results obtained in experimenting on the two samples of crude and the sample of burning naphtha, the benzole having been separated from the latter by fractional distillation. In the crude naphtha, there always exists a large proportion of tarry matter and naphthaline, and with a gravity approaching to 890 as compared with burning naphtha, which has been freed from all tarry matter, and has a gravity not exceeding 860; it is not to be expected that the crude will give off vapour as readily as the refined. This has been the case, however, as is indicated by the table of results. The crude gave off

vapour at a much lower temperature than the refined burning naphtha; and the same remark applies to the results obtained from crude and refined paraffin oils from which paraffin spirit has been separated. In the case of spirit of wine and different proportions of water, and also of liquids that will mix with water, a deduction from the specific gravity might be made, which would at once indicate the igniting point of the vapour, and also the percentage of spirit in it; this, however, I have not gone into. The proportion of volatile matters to be found in different crude commercial substances is exceedingly variable, and therefore no line for guidance do I offer; but in manufactured articles of commerce, where a volatile and a less volatile mixture are together, the manufacturer and the merchant have it in their power to exact a standard at which the vapour will not ignite. A very small percentage of a volatile compound is sufficient to make the whole bulk dangerous, and in some instances accidents from this circumstance are very apt to arise. In the printed table I have light pitch oil, the vapour of which explodes at 119° F.; this point of ignition is not what is considered at all dangerous as compared with bisulphide of carbon or benzole; it is, however, equally dangerous, and for this reason—that the latter is known to give off inflammable vapour which ignites at a low temperature, while the former, on account of its familiar name—pitch oil, or creosote—is looked upon as not at all explosive. In this sample of light pitch oil, the volatile matter which gave off inflammable gas at 119° did not exceed 2 per cent, after which no combustible vapour was given off until a temperature of 180° was reached, thus clearly showing that the low explosive points of the vapours of some commercial substances depend upon a very small percentage of volatile extraneous matter.

Now I shall explain the small apparatus used in estimating the igniting point of the vapours, and which is very simple.

It consists of a water-bath, with basin thermometer and spirit lamp. In operating, I put the same quantity of cold water into the bath each trial, in order that the time required to raise the temperature of the water is as nearly as possible the same. Into the small basin I put a known measure of the liquid under examination (in this instance, also, the same volume is always used); the thermometer is then adjusted with the bulb immersed under the liquid in the basin. The spirit lamp is now lighted and placed under the bath—the water in the bath is gradually warmed, which, in its turn, heats the liquid under trial. The rise of temperature is indicated by the thermometer, and by means of a lighted taper and careful attention it is easy to catch the first flash of vapour evolved. In order to have exact comparative trials, it is not only essential to have all the experiments conducted on the same principle, as regards detail, but it is also of the greatest importance that the surface of the liquid, and the taper used in catching the exact point at which the vapour explodes, shall be at an equal distance in each case. This point is of the first importance to all who test the igniting point of vapours; and to explain this statement more clearly, I have printed on the table the results of experiments made on the same commercial samples, keeping the lighted taper $1\frac{1}{2}$ inches from the surface of the liquid, in one case, and in the other at only half an inch from the surface of the sample under trial. The results are as expected—when the vapour

has to diffuse and mix with atmospheric air through a space of $1\frac{1}{2}$ inches, it is found that a greater temperature is required in order to evolve the larger quantity of vapour, than in the experiments of only half an inch between the lighted taper and sample; and this is explained by the circumstance that the vapour, immediately on being liberated, mixes with the small volume of atmospheric air in the experimental basin, forming with it a mixture which, on meeting a light, explodes. In the other set of experiments, a greater temperature is required to disengage a larger volume of vapour to mix with the greater proportion of air.

In this paper I have carefully avoided mention of the relative danger of the articles of commerce examined by me; the table gives, however, the names of several compounds the vapours of which readily explode, and it is with the object of having a uniform method of testing that point of danger that I now submit a method which I consider sufficiently accurate for all comparative trials. Without a uniform method no two results will agree; but with a recognised method, both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a security to consumers and others that does not now exist would be obtained.

NOTE.—The Petroleum Act of 1868 enforces a uniform method of testing the point at which vapours are evolved to form explosive mixtures with air; but this applies only to paraffin, petroleum, and coal oil products, and does not refer to other commercial substances, several of which are equally, and others more dangerous, than paraffin and petroleum oil.

Dr. WALLACE gave additional information relating to the new Petroleum Act, and described the apparatus which must be used for testing in order to conform to its requirements.

Dr. CLARKE stated that, in the case of liquids having a low inflaming point, the temperature at which the first flash took place was generally only a few degrees below that at which the bulk of the liquid was inflammable, but that with liquids which had a high inflaming point, the temperature at which the first flash took place was removed from that at which the liquid itself inflamed; by 10° or even more. He also stated that he believed the insurance companies had divided oil into three classes, having different inflaming points—the first, or least inflammable, being represented by olive oil; the second, by Price's cloth oil, which ignites at about 346° F.; and the third embracing all oils having a lower igniting point than Price's cloth oils, a margin of a few degrees being allowed. He also pointed out that the igniting point of an oil (the only test required by insurance companies) was no criterion of the readiness with which it undergoes spontaneous combustion when spread over a cotton surface.

Mr. TATLOCK believed that much misapprehension had arisen from a misunderstanding on the part of commercial men as to the true meaning of the term "igniting point," and referred to the fact that the igniting point, properly so-called, of any gas or vapour was seldom, if ever, under a red heat, whereas the igniting point, commercially speaking, was simply the point at which sufficient vapour was given off to form an explosive mixture with air in contact with a red-hot body, the latter condition requiring always to be fulfilled before an explosion could happen.

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ON THE RELATION OF HYDROGEN TO PALLADIUM.*

BY THOMAS GRAHAM, F.R.S.,

MASTER OF THE MINT.

It has often been maintained on chemical grounds that hydrogen gas is the vapour of a highly volatile metal. The idea forces itself upon the mind that palladium with its occluded hydrogen is simply an alloy of this volatile metal in which the volatility of the one element is restrained by its union with the other, and which owes its metallic aspect equally to both constituents. How far such a view is borne out by the properties of the compound substance in question will appear by the following examination of the properties of what, assuming its metallic character, would fairly be named hydrogenium.

Density.—The density of palladium when charged with 800 or 900 times its volume of hydrogen gas is perceptibly lowered, but the change cannot be measured accurately by the ordinary method of immersion in water, owing to a continuous evolution of minute hydrogen bubbles which appears to be determined by contact with the liquid. However, the linear dimensions of the charged palladium are altered so considerably that the difference admits of easy measurement, and furnishes the required density by calculation. Palladium in the form of wire is readily charged with hydrogen by evolving that gas upon the surface of the metal in a galvanometer containing dilute sulphuric acid, as usual.† The length of the wire before and after a charge is found by stretching it on both occasions by the same moderate weight, such as will not produce permanent distention, over the surface of a flat graduated measure. The measure was graduated to hundredths of an inch, and by means of a vernier, the divisions could be read to thousandths. The distance between two fine cross lines marked upon the surface of the wire near each of its extremities was observed.

Expt. 1.—The wire had been drawn from welded palladium, and was hard and elastic. The diameter of the wire was 0.462 millimetre; its specific gravity was 12.38, as determined with care. The wire was twisted into a loop at each end, and the mark made near each loop. The loops were varnished so as to limit absorption of gas by the wire to the measured length between the two marks. To straighten the wire, one loop was fixed, and the other connected with a string passing over a pulley and loaded with 1.5 kilogramme, a weight sufficient to straighten the wire without occasioning any undue strain. The wire was charged with hydrogen by making it the negative electrode of a small Bunsen's battery consisting of two cells, each of half a litre in capacity. The positive electrode was a thick platinum wire placed side by side with the palladium wire, and extending the whole length of the latter, within a tall jar filled with dilute sulphuric acid. The palladium wire had, in consequence, hydrogen carried to its surface for a period of one and a half hour. A longer exposure was found not to add sensibly to the charge of hydrogen acquired by the wire. The wire was again measured and the increase in length noted. Finally the wire, being dried with a cloth, was divided at the marks, and the charged portion heated in a long narrow glass tube kept vacuum by a Sprengel aspirator. The whole occluded hydro-

* Read before the Royal Society January 14th, 1869.

† *Proceedings of the Royal Society*, p. 422, 1868.

gen was thus collected and measured; its volume is reduced by calculation to Bar. 760 m.m., and Therm. 0° C.

The original length of the palladium wire exposed was 609.144 m.m. (23.982 inches), and its weight 1.6832 grm. The wire received a charge of hydrogen amounting to 936 times its volume, measuring 128 c.c., and therefore weighing 0.01147 grm. When the gas was ultimately expelled, the loss as ascertained by direct weighing was 0.01164 grm. The charged wire measured 618.923 m.m., showing an increase in length of 9.779 m.m. (0.385 inch). The increase in linear dimensions is from 100 to 101.605; and in cubic capacity, assuming the expansion to be equal in all directions, from 100 to 104.908. Supposing the two metals united without any change of volume, the alloy may therefore be said to be composed of—

	By volume.
Palladium.....100	or 95.32
Hydrogenium.....4.908	or 4.68
104.908	100

The expansion which the palladium undergoes appears enormous if viewed as a change of bulk in the metal only, due to any conceivable physical force, amounting as it does to sixteen times the dilatation of palladium when heated from 0° to 100° C. The density of the charged wire is reduced by calculation from 12.3 to 11.79. Again, as 100 is to 4.91, so the volume of the palladium, 0.1358 c.c. is to the volume of the hydrogenium 0.006714 c.c. Finally, dividing the weight of the hydrogenium, 0.01147 grm. by its volume in the alloy, 0.006714 c.c. we find

Density of hydrogenium.....1.708

The density of hydrogenium, then, appears to approach that of magnesium, 1.743, by this first experiment.

Further, the expulsion of hydrogen from the wire, however caused, is attended with an extraordinary contraction of the latter. On expelling the hydrogen by a moderate heat, the wire not only receded to its original length, but fell as much below that zero as it had previously risen above it. The palladium wire first measuring 609.144 m.m., and which increased 9.77 m.m., was ultimately reduced to 599.444 m.m., and contracted 9.7 m.m. The wire is permanently shortened. The density of the palladium did not increase, but fell slightly at the same time, namely, from 12.38 to 12.12; proving that this contraction of the wire is in length only. The result is the converse of extension by wire-drawing. The retraction of the wire is possibly due to an effect of wire-drawing in leaving the particles of metal in a state of unequal tension, a tension which is excessive in the direction of the length of the wire. The metallic particles would seem to become mobile, and to right themselves in proportion as the hydrogen escapes; and the wire contracts in length, expanding, as appears by its final density, in other directions at the same time.

A wire so charged with hydrogen, if rubbed with the powder of magnesia (to make the flame luminous), burns like a waxed thread when ignited in the flame of a lamp.

Expt. 2.—Another portion of the same palladium wire was charged with hydrogen in a similar manner. The results observed were as follows:—

Length of palladium wire..... 488.976 m.m.

The same with 867.15 volumes of	
occluded gas.....	495.656 m.m.
Linear elongation.....	6.68 "
Linear elongation on 100.....	1.3663 "
Cubic expansion on 100.....	4.154 "
Weight of palladium wire.....	1.0667 grm.
Volume of palladium wire.....	0.08072 c.c.
Volume of occluded hydrogen gas....	75.2 "
Weight of same.....	0.00684 grm.
Volume of hydrogenium.....	0.003601 c.c.
From these results is calculated—	
Density of hydrogenium.....	1.898.

Expt. 3.—The palladium wire was new, and on this occasion was well annealed before being charged with hydrogen. The wire was exposed at the negative for two hours, when it had ceased to elongate.

Length of palladium wire.....	556.185 m.m.
Same with 888.303 volumes hydrogen	563.632 "
Linear elongation.....	7.467 "
Linear elongation on 100.....	1.324 "
Cubic expansion on 100.....	4.025 "
Weight of palladium wire.....	1.1675 grm.
Volume of palladium wire.....	0.0949 c.c.
Volume of occluded hydrogen gas....	84.3 "
Weight of same.....	0.007553 grm.
Volume of hydrogenium.....	0.003820 c.c.
These results give by calculation—	
Density of hydrogenium.....	1.977

It was necessary to assume in this discussion that the two metals do not contract nor expand, but remain of their proper volume on uniting. Dr. Matthiessen has shown that in the formation of alloys generally the metals retain approximately their original densities.*

In the first experiment already described, probably the maximum absorption of gas by wire, amounting to 935.67 volumes, is attained. The palladium may be charged with any smaller proportion of hydrogen by shortening the time of exposure to the gas (329 volumes of hydrogen were taken up in twenty minutes), and an opportunity be gained of observing if the density of the hydrogenium remains constant, or if it varies with the proportion in which hydrogen enters the alloy. In the following statement, which includes the three experiments already reported, the essential points only are produced:—

TABLE.

Volumes of Hydrogen occluded.	Linear expansion in millimetres.		Density of Hydrogenium.
	From	To	
329	496.189	498.552	2.055
462	493.040	496.520	1.930
487	370.358	373.126	1.927
745	305.538	511.303	1.917
867	488.976	495.656	1.898
888	556.185	563.652	1.977
936	609.144	618.923	1.708

If the first and last experiments only are compared it would appear that the hydrogenium becomes sensibly denser when the proportion of it is small, ranging from 1.708 to 2.055. But the last experiment of the table is perhaps exceptional, and all the others indicate considerable uniformity of density. The mean density of hydrogenium, according to the whole experiments, excluding that last referred to, is 1.951, or nearly 2. This uniformity is in favour of the method followed for estimating the density of hydrogenium.

On charging and discharging portions of the same palladium wire repeatedly, the curious retraction was

* *Philosophical Transactions*, 1860, p. 177.

found to continue, and seemed to be interminable. The following expansions, caused by variable charges of hydrogen, were followed on expelling the hydrogen by the retractions mentioned:—

	Elongation.	Retraction.
1st experiment	9.77 m.m.	9.70 m.m.
2nd "	5.765 "	6.20 "
3rd "	2.36 "	3.14 "
4th "	3.482 "	4.95 "
		23.99

The palladium wire, which originally measured 609.144 m.m., has suffered by four successive discharges of hydrogen from it, a permanent contraction of 23.99 m.m.; that is, a reduction of 5.9 per cent in its original length. The contractions will be observed to exceed in amount the preceding elongations produced by the hydrogen, particularly when the charge of the latter is less considerable. With another portion of wire the contraction was carried to 15 per cent of its length by the effect of repeated discharges. The specific gravity of the contracted wire was 12.12, no general condensation of the metal having taken place. The wire shrinks in length only.

In the preceding experiments the hydrogen was expelled by exposing the palladium placed within a glass tube to a moderate heat short of redness, and exhausting by means of a Sprengel tube; but the gas was also withdrawn in another way—viz., by making the wire the positive electrode, and thereby evolving oxygen upon its surface. In such circumstances, a slight film of oxide of palladium is formed on the wire, but it appears not to interfere with the extraction and oxidation of the hydrogen. The wire measured—

	Difference.
Before charge.....	443.25 m.m.
With hydrogen.....	449.90 " + 6.65 m.m.
After discharge.....	437.31 " - 5.94 "

The retraction of the wire, therefore, does not require the concurrence of a high temperature. This experiment further proved that a large charge of hydrogen may be removed in a complete manner by exposure to the positive pole—for four hours in this case; for the wire in its ultimate state gave no hydrogen on being heated *in vacuo*.

That particular wire, which had been repeatedly charged with hydrogen, was once more exposed to a maximum charge, for the purpose of ascertaining whether or not its elongation under hydrogen might now be facilitated and become greater, in consequence of the previous large retraction. No such extra elongation, however, was observed on charging the retracted wire more than once; and the expansion continued to be in the usual proportion to the hydrogen absorbed. The final density of the wire was 12.18.

The wire retracted by heat is found to be altered in another way, which appears to indicate a molecular change. When the gas has been expelled by heat, the metal gradually loses much of its power to take up hydrogen. The last wire, after it had already been operated upon six times, was again charged with hydrogen for two hours, and was found to occlude only 320 volumes of gas, and in a repetition of the experiment, 330.5 volumes. The absorbent power of the palladium had therefore been reduced to about one-third of its maximum.

The condition of the retracted wire appeared, however, to be improved by raising its temperature to full

redness, by sending through it an electrical current from a battery. The absorption rose thereafter to 425 volumes of hydrogen, and in a second experiment to 422.5 volumes.

The wire becomes fissured longitudinally, acquires a thready structure, and is much disintegrated on repeatedly losing hydrogen; particularly when the hydrogen has been extracted by electrolysis in an acid fluid. The palladium in the last case is dissolved by the acid to some extent. The metal appeared, however, to recover its full power to absorb hydrogen, now condensing upwards of 900 volumes of gas.

The effect upon its length of simply annealing the palladium wire by exposure in a porcelain tube to a full red heat, was observed. The wire measured 556.075 m.m. before, and 555.875 m.m. after heating; or a minute retraction of 0.2 m.m. was indicated. In a second annealing experiment, with an equal length of new wire, no sensible change whatever of length could be discovered. There is no reason, then, to ascribe the retraction after hydrogen, in any degree, to the heat applied when the gas is expelled. Palladium wire is very slightly affected in physical properties by such annealing, retaining much of its first hardness and elasticity.

2. *Tenacity*.—A new palladium wire, similar to the last, of which 100 m.m. weighed 0.1987 grammes, was broken, in experiments made on two different portions of it, by a load of 10 and of 10.17 kilogrammes. Two other portions of the same wire, fully charged with hydrogen, were broken by 8.18, and by 8.27 kilogrammes. Hence we have—

Tenacity of palladium wire.....	100
Tenacity of palladium and hydrogen	81.29

The tenacity of the palladium is reduced by the addition of hydrogen, but not to any great extent. It is a question whether the degree of tenacity that still remains is reconcilable with any other view than that the second element present possesses of itself a degree of tenacity such as is only found in metals.

3. *Electrical Conductivity*.—Mr. Becker, who is familiar with the practice of testing the capacity of wires for conducting electricity, submitted a palladium wire, before and after charging with hydrogen, to trial, in comparison with a wire of German silver of equal diameter and length, at 10.5°. The conducting-power of the several wires was found as follows, being referred to pure copper as 100:—

Pure copper.....	100
Palladium.....	8.10
Alloy of 80 copper + 20 nickel..	6.63
Palladium + hydrogen.....	5.99

A reduced conducting power is generally observed in alloys, and the charged palladium wire falls 25 per cent. But the conducting power remains still considerable, and the result may be construed to favour the metallic character of the second constituent of the wire. Dr. Matthiessen confirms these results.

4. *Magnetism*.—It is given by Faraday as the result of all his experiments that palladium is "feebly but truly magnetic;" and this element he placed at the head of what are now called the paramagnetic metals. But the feeble magnetism of palladium did not extend to its salts. In repeating such experiments, a horse-shoe electro-magnet of soft iron, about 15 centimetres (6 inches) in height, was made use of. It was capable of supporting 60 kilogs., when excited by four large

Bunsen's cells. This is an induced magnet of very moderate power. The instrument was placed with its poles directed upwards; and each of these was provided with a small square block of soft iron terminating laterally in a point, like a small anvil. The palladium under examination was suspended between these points in a stirrup of paper attached to three fibres of cocoon silk, 3 decimetres in length, and the whole was covered by a bell glass. A filament of glass was attached to the paper, and moved as an index on a circle of paper on the glass shade divided into degrees. The metal, which was an oblong fragment of electro-deposited palladium, about 8 m.m. in length and 3 m.m. in width, being at rest in an equatorial position—that is, with its ends averted from the poles of the electro-magnet—the magnet was then charged by connecting it with the electrical battery. The palladium was deflected slightly from the equatorial line by 10° only; the magnetism acting against the torsion of the silk suspending thread. The same palladium charged with 604.6 volumes of hydrogen was deflected by the electro-magnet through 48° , when it set itself at rest. The gas being afterwards extracted, and the palladium again placed equatorially between the poles, it was not deflected in the least perceptible degree. The addition of hydrogen adds manifestly, therefore, to the small natural magnetism of the palladium. To have some terms of comparison, the same little mass of electro-deposited palladium was steeped in a solution of nickel of sp. gr. 1.082, which is known to be magnetic. The deflection under the magnet was now 35° , or less than with hydrogen. The same palladium being afterwards washed and impregnated with a solution of protosulphate of iron of sp. gr. 1.048, of which the metallic mass held 2.3 per cent of its weight, the palladium gave a deflection of 50° , or nearly the same as with hydrogen. With a stronger solution of the same salt, of sp. gr. 1.17, the deflection was 90° , and the palladium pointed axially.

Palladium in the form of wire or foil gave no deflection when placed in the same apparatus, of which the moderate sensitiveness was rather an advantage in present circumstances; but when afterwards charged with hydrogen, the palladium uniformly gave a sensible deflection of about 20° . A previous washing of the wire or foil with hydrochloric acid, to remove any possible traces of iron, did not modify this result. Palladium reduced from the cyanide and also precipitated by hypophosphorous acid, when placed in a small glass tube, was found to be not sensibly magnetic by our test; but it always acquired a sensible magnetism when charged with hydrogen.

It appears to follow that hydrogenium is magnetic, a property which is confined to metals and their compounds. This magnetism is not perceptible in hydrogen gas, which was placed both by Faraday and M. E. Becquerel at the bottom of the list of diamagnetic substances. This gas is allowed to be upon the turning-point between the paramagnetic and diamagnetic classes. But magnetism is so liable to extinction under the influence of heat that the magnetism of a metal may very possibly disappear entirely when it is fused or vapourized, as appears with hydrogen in the form of gas. As palladium stands high in the series of the paramagnetic metals, hydrogenium must be allowed to rise out of that class, and to take place in the strictly magnetic group, with iron, nickel, cobalt, chromium, and manganese.

Palladium with Hydrogen at a High Temperature.—The ready permeability of heated palladium by hydro-

gen gas would imply the retention of the latter element by the metal even at a bright red heat. The hydrogenium must, in fact, travel through the palladium by cementation, a molecular process which requires time. The first attempts to arrest hydrogen in its passage through the red-hot metal were made by transmitting hydrogen gas through a metal tube of palladium with vacuum outside, rapidly followed by a stream of carbonic acid, in which the metal was allowed to cool. When the metal was afterwards examined in the usual way, no hydrogen could be found in it. The short period of exposure to the carbonic acid seems to have been sufficient to dissipate the gas. But on heating palladium foil red-hot in a flame of hydrogen gas, and suddenly cooling the metal in water, a small portion of hydrogen was found locked up in the metal. A volume of metal amounting to 0.062 c.c. gave 0.080 c.c. of hydrogen; or, the gas, measured cold, was 1.306 times the bulk of the metal. This measure of gas would amount to three or four times the volume of the metal at a red heat. Platinum treated in the same way appeared also to yield hydrogen, although the quantity was too small to be much relied upon, amounting only to 0.06 volume of the metal. The permeation of these metals by hydrogen appears, therefore, to depend on absorption, and not to require the assumption of anything like porosity in their structure.

The highest velocity of permeation observed was in the experiment where four litres of hydrogen (3992 c.c.), per minute passed through a plate of palladium 1 m.m. in thickness, and calculated for a square metre in surface, at a bright red heat a little short of the melting point of gold. This is a travelling movement of hydrogen through the substance of the metal with the velocity of 4 m.m. per minute.

The chemical properties of hydrogenium also distinguish it from ordinary hydrogen. The palladium alloy precipitates mercury and calomel from a solution of the chloride of mercury without any disengagement of hydrogen; that is, hydrogenium decomposes chloride of mercury, while hydrogen does not. This explains why M. Stanislas Meunier failed in discovering the occluded hydrogen of meteoric iron, by dissolving the latter in a solution of chloride of mercury; for the hydrogen would be consumed, like the iron itself, in precipitating mercury. Hydrogen (associated with palladium) unites with chlorine and iodine in the dark, reduces a persalt of iron to the state of protosalt, converts red prussiate of potash into yellow prussiate, and has considerable deoxidising powers. It appears to be the active form of hydrogen, as ozone is of oxygen.

The general conclusions which appear to flow from this inquiry are—that in palladium fully charged with hydrogen, as in the portion of palladium wire now submitted to the Royal Society, there exists a compound of palladium and hydrogen in a proportion which may approach to equal equivalents;* that both substances are solid, metallic, and of a white aspect; that the alloy contains about 20 volumes of palladium united with one volume of hydrogenium; and that the density of the latter is about 2, a little higher than magnesium, to which hydrogenium may be supposed to bear some analogy; that hydrogenium has a certain amount of tenacity, and possesses the electrical conductivity of a metal; and, finally, that hydrogenium takes its place among magnetic metals. The latter fact may have its bearing upon the appearance of hydrogenium in me-

* *Proceedings of the Royal Society*, 1868, p. 425.

teoric iron, in association with certain other magnetic elements.

I cannot close this paper without taking the opportunity to return my best thanks to Mr. W. C. Roberts for his valuable co-operation throughout the investigation.

ON THE

SULPHATES OF OXIDE OF ANTIMONY.

BY W. P. DEXTER.

THE various degrees of saturation of acids with the basic oxides have been considered either in general, as different classes of salts, or have been studied in detail, as combinations of the individual bases. The recent Memoir of Hr. Schultz, of Berlin,* has added largely to the number of compounds known as acid salts. In a work now nearly finished, I hope to show that, of the alum-forming bases, the sulphates of alumina and sesquioxide of chrome are capable of combining with an equivalent of hydrated sulphuric acid; that these acid sulphates stand in close connection with the so-called double salts of the neutral sulphates of these bases; and that they may be regarded as compound acids, of which the double sulphates are the derivative salts. With the view of extending this inquiry to the salts of an oxide of similar composition, but of a different class, the following examination of the combinations of sulphuric acid with oxide of antimony was undertaken. No compound was here found analogous to the acid-sulphates of the alum bases, as no salt of oxide of antimony is known which has the composition of the alums. These compounds have been previously investigated by Brandes, and more recently, and with somewhat different result, by M. Péligot. My own conclusions agree, as will be seen, with those of the German chemist; but are given, with hesitation, from experience of the difficulties with which the preparation of these bodies is attended.

For the purpose of demonstrating their existence, and examining their form under the microscope, the salts are easily made by boiling oxide of antimony or Algaroth powder with dilute sulphuric acid, until the water of the acid is expelled. The bisulphate remains as a white sandy powder, while the concentrated acid deposits on cooling acicular crystals of the tersulphate or neutral salt. By the action of hot water, these are converted into minute crystals of the disulphate. If the concentration of the acid has not been carried so far, intermixed with, or in place of, the bisulphate will be found crystals of an intermediate salt, of different form; and the liquid, if allowed to attract moisture from the air, deposits still other crystalline compounds, one of which contains equal equivalents of acid and base.

These are the salts which I have succeeded in obtaining in a sufficiently pure state for analysis. They are all crystalline, dissolve readily in hydrochloric acid, and with the exception of the disulphate, are decomposed by the action of water. To free them from the adhering acid liquid, they were left for a considerable time upon a porous earthen plate, protected from moisture by a glass containing a vessel of concentrated sulphuric acid. For the plates nothing was here to be found better than the red earthen saucers upon which flower-pots are placed. I had also flat discs made of the same ware, between which the salts, when par-

tially dried, were forcibly pressed by means of a steel screw. The plates, before use, were heated, first in an oven, and then over a large gas flame, or an anthracite fire, and left to cool in a close vessel, over sulphuric acid.

For analysis the salts were dissolved in hydrochloric acid, tartaric added so that the solution could be largely diluted without precipitation, and the antimony thrown down by sulphydric acid: the sulphuric acid was then determined in the filtrate as sulphate of baryta. If, on the contrary, the sulphuric acid be precipitated before the separation of the antimony, a sulphate of baryta is obtained, which after ignition is coloured, and retains traces of the metal that cannot be wholly removed by digestion with dilute hydrochloric acid. All the tartaric acid of commerce which I have examined, contains sulphuric acid; digestion of the solution in alcohol with a little carbonate of baryta removes the acid, but the tartrate of baryta is not quite insoluble in the alcoholic liquid. With carbonate of lime no better result was obtained. Through the kindness of Mr. Melvin, druggist of Boston, I received a supply of tartaric acid, in large crystals, which were quite free from sulphuric acid and all metallic impurity.

The precipitated sulphide of antimony was collected on a weighed filter, and dried at the temperature of boiling water; from its weight the quantity of the metal or oxide was calculated. As the antimony was in the state of oxide, and no nitric acid, oxide of iron, or other substance capable of decomposing the sulphydric acid, was present, an excess of sulphur in the precipitate was not to be feared. It has been asserted that the tersulphide of antimony retains at 100° C. a quantity of water, not amounting to 1 per cent, and requiring for its expulsion a temperature above 200°, by which the sulphide is converted into the black crystalline modification. To determine the precise amount of the error from this source, as well as from the possible presence of uncombined sulphur, the sulphide, after remaining many hours in the water bath, and until its weight varied, at most, one or two-tenths of a milligramme, was heated in a covered crucible, in an air bath, to 212°—220° for half or three-quarters of an hour at a time, with the following result:—

0.8192 SbS ₂	lost	2.1	0.4	0.5
0.5445 "	"	1.0	0.3	milligrammes,

no constant weight being obtained.

The sulphide was then exposed to the same temperature, in a bulb blown upon a narrow glass tube, while the air was displaced by a slow stream of carbonic acid.

0.8536	lost	0.2
0.5199	"	0.5
0.6488	"	0.4
0.3920	"	0.25 milligrammes,

these being all products of different analyses; the sulphide was completely converted into the black modification, and the weight on repeated trial remained unchanged. The error, whatever may be its source, of at most the tenth of 1 per cent, becomes insignificant when compared with the tenfold greater errors inevitable in the preparation of the salts.

Tersulphate, or Neutral Salt.—Oxide of antimony and Algaroth powder are dissolved in considerable quantity by hot concentrated sulphuric acid, the latter with disengagement of hydrochloric acid, the solvent power of the acid seeming to increase with its temperature. On cooling, a salt is deposited in slender

* Pogg. Ann., cxxxiii., 137.

needles, in such quantity, when the acid is saturated at its boiling point, that the whole becomes a thick semi-fluid magma. The crystals are long, four-sided prisms, with terminal faces, set often upon two opposite sides, alike at both ends of the prism. They seem to belong to the oblique rhombic system. The concentrated acid in which they have formed retains so little of the oxide in solution at the ordinary temperature that it remains clear when diluted with water, but by sulphydric acid a slight precipitate is produced. In the acid, diluted with about half its volume of water, the oxide in the cold is much more soluble.

In the preparation of the salt, the oxychloride was used in preference to the oxide, as the latter is not easily obtained free from alkali, and the acid was heated until all water was expelled, and vapour of hydrated acid abundantly given off. The semi-fluid mass of crystals was brought upon a funnel, the neck of which was imperfectly closed by a glass rod, and they were then further freed from the acid upon the porous plates, as has been described. These operations were performed as rapidly as possible, in frosty wintry weather, and in a room which was not heated, and was entered for no other purpose. When dry, the salt formed a mass of fibrous texture, very much resembling asbestos.

My analysis shows this to be the tersulphate, or neutral salt:—

1. 0.5933 of the salt gave 0.3648 SbS_3 .
2. 0.6792 of the same preparation gave 0.4173 SbS_3 , and 0.918 BaOSO_3 .
3. 0.6413 of another preparation gave 0.3999 SbS_3 , and 0.859 BaOSO_3 .

	Calculated.	I.	II.	III.
SbO_2	54.94	52.82	52.78	53.58
3SO_2	45.06	—	46.41	46.00
	100.00		99.19	99.58

The difference in the numbers found in the analyses from those given by calculation is to be ascribed to impurity of the preparations, rather than to analytical errors. It is obviously difficult, by pressure between rigid plates, to remove completely all adherent liquid, and an excess of acid was therefore generally found in the salts thus prepared. That this was in the present case the cause of the discrepancy will appear when it is considered that the acid which adhered to the salt was hydrated acid, and that its water would be represented in the analysis by a loss. The loss, then, should correspond in amount to the excess of acid obtained; or, reckoned in equivalents as water, should be equal to the equivalents of the acid in excess.

The composition of the salt from the above analyses, taken in equivalents, is—

	II.	III.
SbO_2	1.00	1.00
SO_2	3.22	3.14
HO (loss)	0.25	0.13

The earlier analyses gave—

	Brandes.	Péligot.*
SbO_2	56.4	50.2
SO_2	43.2	51.9
	99.6	102.1
		97.4

* The requisite data for calculation are given only for the first of the analyses of M. Péligot. If there be not a misprint, there is an error in this calculation, as occurs also in three out of the four analyses of the sulphates of antimony, of which the details are given. If from 1.66 of the salt, 2.22 BaOSO_3 were obtained, as stated in the memoir there were 45.9 per cent of acid, instead of 51.9.

Mr. Péligot considers the salt to contain four atoms of acid, a composition which requires 47.77 SbO_2 , to 52.23 SO_2 , if the equivalent of antimony be taken, as has been here done, at 122.34.* The question is one of considerable importance; for from the composition which he has assigned to this sulphate, and to the other antimonial compounds described in his Memoir, M. Péligot infers that the salts of antimony, like those of uranium, depart from the recognized law, according to which oxides containing three equivalents of oxygen require the same number of atoms of acid to form a neutral salt. The existence of such a sulphate of oxide of antimony is denied by him. "En effet il ne m'a pas été possible de rencontrer un seul sel contenant 3 équivalents d'acide combiné avec 1 équivalent d'oxyde d'antimoine; de sorte que pour les sels d'antimoine, de même que pour les sels jaunes d'urane, toutes les formules calculées dans les tables d'équivalents de M. Berzelius représentent des sels qui n'existent pas."†

But the neutral salt may be prepared in another way, with a composition agreeing so nearly with that required by theory as to leave no doubt of its existence. By careful heating in a crucible of the oxide or oxychloride of antimony, with sulphuric acid, until the excess of acid is expelled, a white residue is obtained, the weight of which, however, is not quite constant, a minute quantity of acid being continually given off, probably on account of the moisture of the air. To obviate this source of uncertainty, the oxide or oxychloride was put into a bulb blown on the end of a narrow and thick glass tube, bent in the shape of a retort, close to the bulb. The neck was then drawn out so as to end in a point, in which, during the distillation, a drop of acid remained, and deprived of its moisture any air which might pass through it. A platinum crucible, lined with asbestos, served as a bath, and was covered with a sheet of mica, perforated for the passage of the neck, over which asbestos was also heaped. The heat was such as just to cause the acid to distil slowly over, the distillation from between one and two grammes of oxychloride lasting several hours: the temperature was above the melting point of lead. At the end, a minute drop collected in the point, at intervals of from a quarter to half an hour. By too long continuance of the heat the vapour of water-free acid is seen in the tube. The acid in the neck having been driven off, the point was sealed with the blow-pipe. The product was a coherent, friable mass, crystalline on the surface to the naked eye.

Of a preparation made from the oxide, 0.4471 gave 0.2823 SbO_2 and 0.5953 BaOSO_3 ; of a salt made from Algroth powder, 0.6177 gave 0.3946 SbS_3 , and 0.815 BaOS_2 ; in the hundred,

	Calculated.	I.	II.
SbO_2	54.94	54.24	54.88
SO_2	45.06	45.72	45.31
	100.00	99.96	100.19

(To be continued.)

* Pogg. Ann., c., 563; Proceedings of the Am. Acad., Jan., 1862.
† Ann. Ch. Phys., 3d Ser., xx., 297.

LECTURES.

ON THE
CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES *

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.
(FULLERIAN PROFESSOR OF CHEMISTRY IN THE ROYAL INSTITUTION).

LECTURE I.

MARBLE—LIME—CARBONIC GAS.

MARBLE, a brittle solid, capable of being crushed and ground into powder—Its want of action on, and insolubility in, water—Occurrence of effervescence on treatment of marble with vinegar or acetic acid; also with other acids, as muriatic acid, for instance—Effervescence due to liberation of a particular kind of air or gas—Same kind of air or gas evolved from marble by action of a red heat—Marble resolved by ignition into above kind of air or gas, and a residue of quicklime—Resulting quicklime distinguished from original marble in various ways—Non-occurrence of effervescence on its being treated with acids—Evolution of heat on its being slaked by water—Its solubility in water—Lime-water characterised by its alkaline reaction upon vegetable colouring matters, and its precipitation of different metallic salts—Combination with lime of the air evolved from marble, to reproduce marble—Chemical identity of marble with chalk, limestone, calc-spar, coral, pearl, &c.—Solubility of all these substances in muriatic acid with effervescence, and their conversion into quicklime by ignition—Extinction of flame of ordinary combustibles by air evolved from marble—Combustion of different metals, as iron, zinc, magnesium, and sodium, in ordinary air—Combustion of sodium in air from marble, with separation of carbon or charcoal—Air from marble formerly called fixed air on account of its being fixed or absorbed by lime, so as to produce chalk—Now called carbonic gas, from its containing carbon or charcoal—Production of carbonic gas by burning charcoal in ordinary air—Conversion of soluble lime into insoluble chalk or marble, a test for carbonic gas.

THOSE of you who are sitting in the front benches, and the no less youthful Fellows whom I see scattered about the theatre, who form my especial audience to-day, have, I suppose, most of you, very recently been acquiring at school much valuable knowledge with regard to words, and numbers, and events; and now in your holiday time, like many generations of schoolboys before you, you come to the Royal Institution to learn a little about *things*—about material objects that can be touched and handled and weighed; and in a little time I think most of you will be surprised to find how very interesting and how curious the properties of even the most common-place things are when intelligently examined, and in particular how very remarkable are the changes which this common and, at first sight, uninteresting looking substance—charcoal—is capable of undergoing and effecting.

Now although it is my intention to talk to you about charcoal or carbon, I do not intend to begin with carbon, but with a very different looking substance—one which you may be inclined to think can have but little connection with charcoal at all, and yet which in reality, as I hope to show you, has a very intimate connection with it indeed.—I mean the substance I hold in my hand, and which you will at once recognise as a piece of marble—a slab of marble.

Now, as we have only some half-dozen hours to talk of the many wonderful changes of this wonderful charcoal, we will put aside all preliminaries, and begin at once with an experimental enquiry into the properties of this white substance, marble, and its relation to that black substance, charcoal. We will submit it to several tests or trials, and we will see how it behaves under those trials; and, first of

all, we will try the effect of a blow upon it. If we take the marble, and hit it a rather sharp blow with a hammer, you will observe that the marble very quickly breaks to pieces. Here we have a number of similar pieces of marble that have been broken off in this manner; here we have a jar of broken marble, and here is the same marble in a smaller state of division. Now, if I take some ordinary pieces of marble, and put them into a druggist's mortar and bring the pestle down upon them, I have the power of reducing them to a powder of a greater or less degree of fineness. Here we have some marble which has been powdered in this manner; here is some in a rather coarser state; here, again, is some which has been very finely powdered for a special purpose; and by chemical means we can get the marble into a much finer state of division, which we speak of as precipitated marble. Well, then, the first thing we learn about marble is, that it is a very brittle substance. That is not a great deal to know, but it is something; and you will find in science that there is no fact, however small, that may not be found important. If I put a piece of lead under the hammer and strike it I cannot break it; or if I put a piece into a mortar I cannot powder it. Marble, then, is a substance entirely different from lead in these respects, inasmuch as the marble possesses a property of brittleness which is not possessed by lead.

So much, then, for the effect of a blow upon marble. Now let us try it in some other way; and first of all we will treat it with water. In these vessels are two large thermometers, which I hope will be visible over the greater part of the theatre; one of these vessels contains a substance which is somewhat of the nature of common salt; it is not ordinary common salt; but it is a substance called salt cake—a kind of salt that cakes together a good deal; in the other vessel there is common marble. Now we are going to wet both these substances, and to notice what happens. We will take a little water, and first of all we will wet this salt substance a little with the water, and observe what takes place. And, now, having wetted the salt substance, we will wet the marble, and notice whether any difference is observable between the two cases. I think that you will find, in the course of a very few minutes, that the liquid of this thermometer which is placed in the salt cake, and which originally stood rather lower than the other thermometer, will rise rapidly, showing that we get a large amount of heat evolved. Salt cake, then, is a substance which, when moistened with water, gives out a considerable amount of heat; whereas marble is a substance which, when wetted, does not give out heat. You see that already the liquid in the thermometer connected with the salt cake is gradually rising, and it will go on rising. I have no doubt, until eventually it reaches up to the very top of the stem. [At a subsequent stage of the lecture the professor pointed out that the thermometer had risen to a considerable height.] We find, then, that there is in this respect a difference between the marble and the other substance.

And now let us try the effects of water upon marble in some other ways. You know that there are many substances which, when they are put into water, disappear; in other words, they dissolve in the water. Certain other substances do not disappear; you have a very good illustration of this in the case of sea salt and sea sand. You have observed, when you have been by the sea side, that the sea salt remains in the water, whereas the sand is deposited upon the shore. Now let us ascertain whether marble is a substance which, like sea salt, dissolves in water, or, like sea sand, remains undissolved. As I have compared the marble with the lead and with the salt cake, I will now compare it with certain substances which are soluble in water. Here I will take a substance which possesses a colour: it is some of the substance called aniline blue,—one of the colours made from coal tar. We will throw some of this blue colour into water, and now notice what happens. You see the beautiful streaks of colour which are gradually de-

* Reported verbatim, by permission of the Author, for this Journal.

ascending. You see in this case, in fact, that we are dealing with a soluble substance—a substance which dissolves very rapidly in water, and by its solution gives rise to these beautiful streaks of colour. Here, then, we have an illustration of a substance which is soluble in water, and at the same time is possessed of a very brilliant colour. We will now pass on to the consideration of another substance. It is one which is not very soluble in water, but is very readily soluble in dilute spirit of wine. We take some of this substance, and put it into the funnel, and pour upon it some spirit of wine, and you see that in this case, also, the substance dissolves very readily in the liquid. You see at the present time a streak of red colouring matter gradually descending through the liquid. Here, then, you have another illustration of a substance which dissolves in water with tolerable facility.

Now, it is quite obvious, we must not compare marble with one of these beautiful coloured substances, but we will compare it with some colourless substance, and for this purpose I will take some common salt. Into this funnel I will pour a quantity of common salt, so as in a great measure to fill the funnel: you see the funnel is now filled with salt. In the other funnel we will place, in the same way, some marble, and we will notice whether any difference is observable in the case of the funnel filled with marble and the funnel filled with salt. In this experiment we shall not see streaks of beautiful colour, but I think those who are near will be able to observe that, in the case of the common salt, there is a stream of liquid—which is, in fact, a solution of salt—descending through the water beneath; whereas nothing of the kind will be observable in the case of the marble. Whether this is observable or not, there is one effect which I think will be noticed by all, and that will be, that in the course of ten minutes or so the whole of the salt which we have put into this funnel will disappear, whereas the marble will remain.

We come, then, to this conclusion—that marble is a substance which, so far as we have gone, does not dissolve perceptibly in water. Here we have some marble in a bottle of water, and it is quite clear that the whole of the marble does not dissolve; but the question chemically is, has *any* of the marble dissolved? Has the water got any marble dissolved in it? I will show you the method which the chemist adopts for the purpose of determining this. He takes a funnel with some filtering paper in it, and he pours the liquid through the funnel; the object of this filtration being to remove any particles of marble which may be undissolved in the water. The question then that we have to consider is whether the filtered water has got any marble in it, and to find out that point we take some of the water and boil it away. You know that when water is boiled it gradually gets less and less in quantity, and eventually it boils entirely away. Now if this water is *nothing but water*, it will boil away and leave no residue; but if it is water containing marble, the water will boil away, and the marble will not boil away, but will be left behind; and thus when we want to know whether the water has taken any marble into solution we filter the liquid, in this way, and then boil it away, and observe whether there is a residue or not. So much then for the action of water upon marble.

The next substance of which we will try the action upon marble is a very common substance, namely, vinegar. For this purpose we will take some finely powdered marble and moisten it thoroughly with water, and then we will act upon it with vinegar. We pour some vinegar upon the marble, and notice whether or not any effect takes place. We shall see in the course of a minute or two that a considerable action is taking place; you will observe that the vinegar will become covered with froth. Now in this case the marble, which would not dissolve in water, is dissolving in the vinegar, and not only is it dissolving, but it is behaving very differently from the manner in which the common salt dissolved in this water [pointing to the solution of salt], and in

which the magenta dissolved in this other vessel. You observe that the marble dissolves in the vinegar with a considerable amount of froth. Now what is the nature of that substance? Vinegar, you know, is a sour substance; to what does it owe its sourness? We find that it contains a sour substance called an acid. Chemists are acquainted with a large number of sour substances called acids, to which they have given different names. This acid contained in vinegar is called the *acid* acid, or *acetic* acid; but the amount of acetic acid existing in vinegar is extremely small. Therefore, if, instead of taking vinegar, we take some of the substance which gives its sourness to vinegar—the acetic acid itself—we shall find, in that case, that the action is much more decided. I will now employ acetic acid instead of vinegar, and you observe in this case that the marble dissolves with considerable rapidity, and we get in this case a much better marked effervescence than we had by means of the vinegar.

Now, as I have said, chemists are acquainted with a great number of different acids. There is this acetic acid, or the acid acid; then there is the acid which exists in sour grapes, and which is called tartaric acid; then there is an acid existing in sour lemons, called citric acid; there is an acid existing in apples, called malic acid, and an acid existing in sorrel, called oxalic acid; then there is an acid got from sulphur, called sulphuric acid; another got from nitre, called nitric acid; and, lastly, there is an acid got from sea salt which is called muriatic acid. Now muriatic acid is the acid which we will try next.

You will find that muriatic acid is an acid which is much stronger than acetic acid, and that when we come to act upon marble with muriatic acid, we shall get a very much more rapid effervescence. In this case, indeed, the effervescence is so rapid, that I shall not need to employ the marble in the fine state of division in which it was when submitted to the action of the other acid. I will take some of this marble in the form of lumps, upon which the vinegar would be almost without action, and upon which the acetic acid would have a very small effect; but with the muriatic acid I can act upon the marble even in the form of these coarse broken pieces, and you see that in this case we get a very violent effervescence.

We have now ascertained these properties as belonging to marble—that when it is subjected to a blow from a hammer it breaks readily; that when exposed to the action of water it does not dissolve; and that when acted on by vinegar, or acetic acid, or muriatic acid, it not only dissolves, but also gives rise to this phenomenon of frothing or effervescence.

Let us now examine into the nature of this effervescence; and for this purpose we will try to perform the experiment in a somewhat different manner. I have here a jar containing some marble, and this marble is covered with water; at the top of the water is an inverted funnel, the object of which you will see presently. In this case, instead of using acetic acid, we will add some of the acid from the sea salt, which we call muriatic acid; and you see that in this case we quickly get an abundant effervescence. We cover this with the funnel and fill up the vessel with water, and in a minute or two you will see what is the nature of this effervescence. You see that it consists in the formation of a large number of bubbles of air underneath the water; and here you see these bubbles of air rushing up through the neck of the funnel into the water above.

Now I wonder whether we can collect any of these bubbles of gas, and find out what sort of air they consist of; we will try. Let us take this glass cylinder and fill it with water, and invert it over the bubbles. If I were to invert the cylinder just as it is after being filled with water, you would find that the air would rush into the cylinder, and the water would simultaneously run out; but if I take the precaution to cover the mouth of the glass with a card, and then invert it so as to keep out the air, under those circumstances the water will remain in the cylinder perfectly well. The air cannot get in, and consequently the water cannot get out. If I put this card on the end of the glass cylinder,

I prevent the air from gaining access, and consequently the water does not escape; when the air cannot get in, the water cannot get out.

I have here another arrangement of the same kind, and by it we will now endeavour to collect some of the gas which is coming up from the marble. I take here a tube, filled with water, and instead of closing it with a card I simply close it with my thumb, and support the end of it under the water over the bubbles of gas; and in this manner, no doubt, we shall be able to collect under the water some of these bubbles of air or gas which are rising from the marble, and which have been generated by the action of the muriatic acid upon the marble. We will now try to get some more of this gas of marble, by acting upon the marble by acid in a bottle instead of in a cylinder. Here is some in a bottle, and in this way we get a considerable effervescence; we put into the neck of the bottle a cork, with a piece of bent tube attached to a piece of vulcanised tube. You see that here we get a jar full of gas in a minute or two, for we are now performing the experiment on a somewhat large scale, while in the other case we performed it on a small scale. This effervescence consists in the formation of bubbles of air beneath the surface of the water, and these bubbles of air we are capable of collecting. In a minute or two we shall have this jar full of the air which is given off from the marble, and then, having obtained it, we shall be able to ascertain its nature. The vessel is now full of the air from marble, and so we will close it with a glass plate and put it aside for a minute or two, until we require it.

We have, then, tried the effect of water and of acids upon our marble; now let us try the effect of heat upon it. For this purpose we will take some of our finely powdered marble, and subject it to the action of a strong heat; and at the same time that I pour some of the marble into this capsule I will also pour some more of the same marble into a glass which shall stand by the side of the capsule, so that when the experiment is complete we may know that we have two specimens of the same substance—one of them being the substance before the action of heat upon it, and the other being the same substance after it has been acted upon by heat. We will take this platinum dish or capsule containing the marble, and act upon it by a strong heat. I will let it be uncovered at first, so that you may see how hot it becomes, and then, in order that the heat may be greater, we will cover it up with this platinum cover, which will cause it to become still hotter. [The dish containing the marble was then submitted to a blowpipe flame.] But I will also expose some marble to heat in another way; instead of putting it into a dish we will put it into this platinum tube, and having filled the tube with marble we will heat it very strongly, and notice what happens. Our tube is now full of marble; we will, therefore, insert in one end of it a cork having a glass tube passing through it, and we will now heat the platinum tube very strongly by means of a blowpipe flame; but before we submit it to the heat we will attach to the glass tube an apparatus for the purpose of ascertaining whether or not any kind of air or gas is given off under these circumstances. For this purpose we will take another glass cylinder and fill it with water, and invert it in a dish of water over the end of the tube from which the bubbles of gas would issue, just as we did in the other case. We are now making our platinum tube very hot by means of the blowpipe, and you will notice in a minute or two whether or not any gas is being evolved. We dip the mouth of the tube underneath the cylinder of water, and you will see that one of the effects of heat upon the marble contained in the tube is to drive off a kind of air or gas.

The point, then, to which we have now arrived is that, whether you act upon marble by an acid, or act upon it by heat, in either case you get evolved a particular kind of air or gas, into the properties of which air or gas we will presently enquire.

The question, then, that arises is this. What is the nature of the gas or air which is given off in these cases? Is the same kind of air given off by the marble under the action of

heat as is given off by it under the action of the acids, or is it a different kind of air? Well, the only way to answer this question, as to answer a great number of others, is to try it. We will try whether the kind of air that is given off by the action of heat is the same kind of air that is given off by the action of the acid, or a different kind of air; and for this purpose we will examine more particularly the nature of the air that is given off by the marble through the effect of the acid upon it. We will take a solution containing lead, which is very well known to medical men under the name of Goulard solution; it is a solution of basic sugar of lead. We will allow the gas given off by the marble to bubble up through our solution of basic sugar of lead, and see whether any action takes place; we see, in point of fact, that there is an effect, and that the solution is rapidly becoming milky. We will now take another portion of the gas given off from the marble under the action of the acid, and try in another way what its properties are; we will take a piece of lighted stick and immerse it in the gas, and it is, as you see, immediately extinguished. Thus we find, then, that the air which is given off from the marble by means of the acid has these two properties; it renders the sugar of lead solution white and turbid, and it extinguishes flame. We will now take a jar of the gas obtained from marble by the action of heat, and observe the effect of this gas upon the solution of sugar of lead. We cause some of the gas that has been produced from the marble by heat to bubble up through a solution of sugar of lead, and you see that in this, as in the other case, the gas evolved from the marble has the property of rendering the basic sugar of lead turbid, just as did the gas evolved from the marble by the action of the acid. In this respect, therefore, the gas evolved from marble by these two different agencies appears to be the same in both instances. Now we will ascertain whether the gas which is evolved from marble by the action of heat has also the property of extinguishing flame. For this purpose we will get our cylinder full of the gas which has been expelled by the heat from the marble, and you see that directly I put in a lighted taper it is extinguished by the gas contained in the cylinder. We have therefore tried the gas produced by these two different methods, and we find that it behaves in the same way in both cases, as far as we have experimented; and, in fact, I may tell you that, no matter how you subject to trial the gases evolved under these different kinds of action, you will find that they always behave the same, or, in other words, that the air given off from marble by the action of heat is identical with the kind of air given off from marble by the action of acids.

Now let us see what sort of a substance is the residue which remains behind; and for this purpose we will examine the substance which we have been subjecting in this way to the action of heat. You will remember that in this beaker we had some of the original marble which we did not expose to heat; and now we will take some of the marble which has been exposed to heat, and see whether or not any difference is observable in the behaviour of the two sorts. Inasmuch as it is possible, or, in fact, very probable, that the action of the heat may not have been pushed sufficiently far, we will not take the whole of the marble which has been exposed to heat, but only a portion of it, and the remainder we will continue to submit to the action of the heat a little longer. Before experimenting with this portion of the marble which has been strongly heated, we will wait a minute or two, that it may become a little cooler; at present it is so hot that I am not well able to bear my hand upon it. When it is cooler I will try the effect of water upon it, and we will see whether the marble which has been thus heated behaves in a different way from the marble which has not been heated. (It is now practically cold, if not absolutely cold; but I can bear my hand upon it.) You will now observe that directly I moisten with water this marble which has been heated, it gives out a great amount of heat and a great quantity of steam, and has now become so hot that it is impossible for any one to bear his hand upon it; whereas this marble which has not

been submitted to the action of heat is quite unaffected by the water with which I moisten it.

We will now go on a little further, and notice whether that marble which has been so strongly heated will effervesce under the action of an acid, and if it does effervesce, whether it effervesces to the same extent as the other marble. In the case of the marble which has been heated, you see we get some effervescence, although not in the same degree; and I am in hopes that in a short time, when the remainder of the heated marble has been subjected to the heat a little longer, we shall get a product which will give us no effervescence.

Hitherto I have been talking about the observation of facts; here, you see, we have got a fact which I did not want, for it was my intention that the marble which had been heated should not effervesce. Now, in science we must interpret the language of facts as they arise. This is an awkward fact; why did it happen? It was because we did not allow the action of the heat to continue sufficiently long. We shall have to go over the experiment again, but for the present you must take my word, that if the marble had been ignited sufficiently long it would no longer have been able to effervesce. I will give you another illustration of the great amount of heat that is produced by this residue when it is wetted. Here we have some large pieces of the residue left after ignition, and upon moistening them we shall get a very considerable amount of heat evolved. You will see the mass begin to steam in a minute or two. It already gets very hot; and if I place upon this mass of residue that has been left after the ignition of marble a piece of phosphorus, you will see that the phosphorus will, in a minute or two, burst into flame. You see the phosphorus now takes fire from the heat that is in this way produced by wetting with water the residue left by the ignition of the marble. Thus you see that the substance which is left by the ignition is a very different substance from the original marble with which we began the experiment. Now we will take a little more of this marble residue, which we will also wet with water, and we will notice whether or not any other remarkable effect takes place through the action of the water. We here take our marble which has been burnt, and we will notice whether or not we get any solution; and for that purpose we will treat this liquid which we pour upon it exactly in the same way as we treated the liquid that was obtained by the action of water upon the marble before it was burnt—that is to say, we will filter it—and then we will take the liquid obtained by the action of water upon the residue of the ignition of marble, and ascertain whether or not water, which would not take up anything from the original marble, will take up anything from this residue of ignited marble. Here I have some of this solution being made—it is filtering through the funnel; but here I have some of the solution already made. First of all we will try its effect upon this piece of paper. Here is a piece of paper almost colourless: we dip it in the solution, and we find that it is dyed almost purple, showing that the water which has been obtained in this way has got something in it. Here is another piece of paper; let us see whether the solution has any effect upon that. You will observe, on my taking out this piece of paper, that, whereas the first piece was stained of a bright red colour, this piece is very quickly stained green—not, I think, so decided a green as the other was a decided red, but still I think it is very apparent; you see, then, that the product obtained by the action of water upon the residue of ignited marble has certain properties. Here we have another piece of paper, and you see that it is dyed brown by the action of the liquid. Here we have a piece of paper which is already red, and on our allowing this to come into contact with the liquid it becomes of a decided blue colour. In this way, then, we are able to ascertain that the liquid that filters away from the residue of the ignition of marble has the property of affecting these bodies in these different ways. But we will try its properties in another way. Here are some ves-

sels containing certain metallic solutions. You will find that the water which has been allowed to digest on marble which has not been ignited, has no effect on the solutions, except that it makes them of a somewhat paler colour by diluting them; whereas I hope to show you that the water from the marble after it has been heated, has a very decided effect. [Portions of the liquid filtered from the calcined marble were added successively to the various metallic solutions.] Here we get a blue precipitate; here we get a black precipitate. To this we add some of the liquid in the same way, and we get a brown; into this, again, we put some of the liquid from the ignited marble, and we get a green; here, again, we get an orange colour. Lastly, we add some to this solution in the same way and we get a white precipitate. Hence you see that, while the water filtered from the unburnt marble has no effect upon these solutions, the water which has acted upon the marble after ignition produces a very decided effect.

Now, what is the nature of this substance which is left behind after the ignition of the marble? Well, this residue is known as "quicklime." When you heat marble in this way you get a substance which differs very much from the original marble; it is no longer marble at all; it has not the property of effervescence with acids, but it has the property of forming a solution with water and giving out heat when moistened. Marble is a substance which does not give out heat on being wetted, and does not dissolve; marble effervesces with acids, but the quicklime does not. So much, then, for the residue.

Now, what is the nature of the gas that is produced when the marble is heated and the residue of quicklime is obtained? Here is an arrangement for obtaining the gas rather more convenient for lecture purposes than the one we employed before. It is exactly of the same character, only in this we have the marble in a separate vessel, and the acid can act upon it at leisure. Here we take some of our lime-water, and we cause some of this gas to bubble through it, and we notice what effect takes place. When we allow the acid to come into contact with the marble we get an abundance of the air or gas given off, and we found that the same air or gas was given off by the marble whether through the action of acid or of heat. We allow some of this gas to act upon this lime-water, and we find that we get a substance identical with the original marble with which we started. We will try this product, and I have no doubt those who are near me will see that a gas is given off when I add muriatic acid to it. [The precipitate effervesced on being treated with acid.]

From what we have seen, then, we conclude that the lime differs from the original marble in the absence of this particular kind of gas or air which the marble gives off when it is heated, and you noticed just now that when we caused this gas to combine again with the lime we got a substance possessing the properties of the original marble; and if we took this precipitate from the lime water and acted upon it with muriatic acid, you saw that we got the gas once more driven off, and the precipitated marble dissolved. The precipitate which was produced we say is chemically the same thing as marble.

Now let me call your attention to some other kinds of marble. Here is a piece of coral; here is a piece of stalactite; here is a piece of calcareous spar; here is a piece of limestone; and here is a piece of shell. If we take, for instance, some of these shells, and cover them with water, and act upon them with muriatic acid, we shall get in this case, as in the other, a considerable amount of effervescence, due to the solution of the shells in the acids and the giving off of a gas. Directly we pour some of this acid upon them, the shells undergo solution, and immediately they effervesce. Well, not only will shells or limestone act thus, but also pearls. For instance, if we take some pearls and act upon them with hydrochloric acid we shall find that the pearls dissolve and give off gas. I have spoken of this gas as being the gas of marble; I might equally well

call it the gas of pearls. We moisten these pearls with water, and act upon them by muriatic acid, and we get in this case a rapid effervescence, and in this way we might collect the gas given off by pearls. You will remember, I dare say, the story of Cleopatra melting her pearl ear-rings in vinegar; well, all I can say is that either her vinegar must have been extremely strong, or she must have taken a very considerable time about it, for pearls dissolve very slowly in vinegar, though they dissolve more readily in this strong muriatic acid. We will facilitate the action of the muriatic acid upon the pearls by the application of a gentle heat, for, in the case of the pearls, although the substance is chemically identical with marble, it is in so compact a state that even the muriatic acid acts upon it very slowly, and the vinegar which Cleopatra employed scarcely acts upon it at all. Here we are collecting our gas from the pearls, and the action will go on in this way until we get our cylinder full of the gas.

I now want to call your attention, for the two or three minutes that remain, to some of the properties of this gas; first of all with reference to the combustion of metals in it; for although the gas given off from marble is not capable of supporting the combustion of ordinary combustibles, nevertheless it can support the combustion of some bodies. In the first place, in order to prove to you that metals will burn, I will show you the combustion of certain metals in air, and then we will take one of them and burn it in the same manner in the gas given off from marble.

I will here ignite some zinc, and then blow a current of air upon it, and you will find that in this way the zinc burns very readily in a current of air. Zinc, then, is a metal capable of burning very readily in air. Now let us try the combustion of the metal magnesium in the air; you have seen that metal burn in the air on several occasions. Here is a piece of magnesium burning in the air very readily and with considerable brilliancy. Now I want to show you the combustion of a metal, both in air and in the gas given off from marble, and that metal is not either of these that we have yet considered; it is the one which I am now about to ignite—metallic sodium. It is now beginning to burn with very great brilliancy, and whilst it is burning let me draw your attention to the remarkable appearance which that coloured diagram presents when illuminated with the light given off by burning sodium. What were seen to be brilliant colours when the magnesium was burning, now look perfectly black under the influence of the sodium light.

The only other experiment to which I wish finally to call your attention, is the combustion of this metal—sodium—not in ordinary air, but in the particular kind of air that is evolved from marble. We take, here, our apparatus which is giving off the gas from the marble, and we cause this gas to flow through pumice-stone, moistened with oil of vitriol for the sake of rendering it dry, and then we will receive it into this flask. We next heat our sodium as we did just now, except that instead of heating it in the open air we will heat it in the flask in a current of this gas, and I want to show you then what the effect will be. [A piece of sodium was deposited in a flask which had been filled with the dried gas; the sodium was then ignited by the application of a blowpipe flame to the exterior of the flask.] The sodium has now, you see, taken fire, and is burning in the gas contained in the flask; and now the only other point that I have to call your attention to is the result of this burning. When we come to examine the contents of the flask, what do we find as the product of the combustion of the sodium in the gas evolved from marble? As soon as the mass at the bottom of the flask ceases to be red hot, I will call your attention to its appearance. You now see that we have here a solid mass of that black substance—charcoal—to which I directed your attention in the beginning of the lecture. Well, now, where did this piece of charcoal come from? This piece of charcoal could not have come out of the sodium, and for this reason,—that if you take this metal and burn it in the air, or in any other gas or under any of the conditions under which sodium is capable of burning, in no case do you get this charcoal except when it is burnt in this

gas which is given off by marble. The point, then, to which we have arrived at the conclusion of this lecture is—that marble is capable of giving off a certain kind of air or gas, and that this air or gas contains charcoal as its essential constituent.

LECTURE II.

CARBONIC GAS—AIR—OXIDES.

Production of carbonic gas by combustions in air of charcoal, of coal, of wood, of candle, and of gas; also by processes of decay, of fermentation, of germination, and of respiration—Discharge of carbonic gas from earth-fissures and mineral springs—Invariable existence of carbonic gas as a constituent of air—Its proportion in the external air very small—Air a material substance, capable of being felt and of being weighed, or having the properties of extension and gravity—Consequences of the weight of air—Existence of different sorts or kinds of air, as ordinary air, fixed air, phlogistic air, vital air, inflammable air, &c.—Some kinds of liquids miscible, others immiscible with each other; but all kinds of air or gas miscible with each other—Ordinary air a mixture, chiefly of two distinct kinds of air—Absorption of about one-fifth of the bulk of ordinary air by different chemical actions, and especially by the rusting of metals, the burning of combustibles, and the breathing of animals.

I FEAR that in my last lecture I did not address myself sufficiently to those of you for whom this course of lectures is especially intended; that is a fault which I must try to mend upon this occasion. To-day, then, we will have the lecture entirely to ourselves, and disregard those full-grown people who sit upon the hinder benches. Now, as I am only going to talk to *you*, I shall not hesitate to venture upon a little recapitulation; and I wish to call your attention to some of the ground that we went over two days ago. You remember we began with marble. I told you that marble is characterised by certain very well defined properties. It is not one of those substances which become hot when moistened with water; it will not dissolve in water, but it does dissolve in acids; and when it dissolves, the act of solution is attended by that particular kind of action which is called effervescence or frothing. Now you will remember that this effervescence really consists in the formation or liberation of a particular kind of air or gas underneath the surface of the water. Here is the solution of the marble in acid going on. You see it is accompanied with an effervescence, and this effervescence consists in the formation of bubbles of air or gas which we are collecting in this tube. Then we spoke of the action of heat upon marble; and you will remember, also, when the marble is heated very strongly—in this tube, for instance—that it gives out a quantity of air, and we find that the air which is given out from marble when subjected to a strong heat is identical with the air given off from marble by the action of acids.

I next proceed to examine the residue; of what does it consist? We find that the residue consists of quicklime, and that this quicklime differs from marble in several particulars.

First, unlike marble, directly we moisten it with water it becomes extremely hot; unlike marble, it dissolves in water, and forms the perfectly clear solution called lime-water. Lime dissolves in water, marble does not; and, unlike marble, the lime, when acted upon by acids, does not give off any kind of air or gas. We find, then, that marble, when strongly heated, is resolved into a particular kind of air or gas which we are here collecting, and into a residue of quicklime capable of being dissolved in water.

Now what will happen if we take some of the gas evolved from the marble by the action of heat, or some of the gas obtained from the action of acids, and pass it through lime-water? Here you see we are separating our marble into quicklime which remains behind, and this particular kind of air or gas which is being collected. Here, again, is the same kind of air or gas—generated in this case by the action of an acid, instead of by the action of heat—and we pass it through our lime-water, and re-obtain a substance which is no longer soluble in water. This substance is, in fact, the same chemical compound as the marble with which we began. In one apparatus we decompose marble into gas and quicklime, and in the other apparatus we reform the marble by combining

with the quicklime the gas evolved from marble by the action of acids. But we may also form marble by using the gas evolved under the action of heat. If, instead of collecting the gas produced from the marble by the action of heat, we allow it to bubble up through this lime-water, you see that in this case, also, we reproduce, in a different form, the marble which we are decomposing by heat in the tube.

Now I call this precipitated substance "marble," but, of course, that is not strictly correct. This substance has the same composition as marble, but it is not marble itself, because we apply the name "marble," not to a substance which merely has the same chemical composition as marble, but to a substance having certain physical properties. You will remember that, on the last occasion we spoke about this piece of marble, I called your attention to the fact that it was a brittle substance; but this precipitate that we have got is no longer brittle; in fact, though it is the same thing *chemically* as marble, it is not the same thing *mechanically*. It is chemically the same thing as marble, in the same sense that shells are the same thing as marble. Shells, for instance, when they are acted upon by acid, dissolve in it like marble, and give rise also to the phenomenon of effervescence. Here we have a piece of coral dissolving in the acid with effervescence, and giving off exactly the same kind of gas as from marble; so that, although we have hitherto spoken of this gas as being the gas from marble, we might also call it the gas from shell, the gas from coral, the gas from limestone, or even the gas from pearls.

Now for a word or two about lime. Lime differs from marble in the fact that it does not effervesce when acids are added to it, and the reason of this you will very readily see. The gas which is given off by heating marble so as to leave the quicklime, is identical with the gas given off by the action of acids upon marble; and if we first drive off all the gas by heat, of course there is no more gas left in the marble to be driven off when we act upon it by acids. The marble so heated no longer effervesces with acids, because the whole of the air which it contained has been driven off by heat. In this way we learn that marble is a compound of the quicklime with the air or gas which is given off.

I told you that this precipitate was chemically the same as marble, and as such it ought to be dissolved by acids with effervescence, like the original marble. [Some muriatic acid was added to the water containing the precipitate suspended in it.] In this case you see we get a considerable amount of effervescence; there is a distinct frothing on the top of the water from the effervescence which is now taking place. Well, all these substances—shell, coral, pearl, this precipitated chalk, and limestone—are converted into quicklime by heating; and all effervesce with acids, giving off this particular kind of gas.

Now, what is the nature of this air which is given off? In the first place, we have seen that it has the property of rendering lime water milky; in the next place we shall find that it has the property of extinguishing the flame of ordinary combustibles. To begin with, we will take this particular portion of gas which we first produced, and lower into it a burning rod of wood. You see the light is immediately extinguished; and not only will the flame of the burning wood be extinguished, but also the flame of burning gas. We introduce a jet of ordinary gas, and it is at once put out; we ascertain, then, that wood and gas are two substances which will not burn in the air evolved from marble. Let us try another substance. We will take this small piece of candle, and observe whether the same thing will happen to it. Our piece of candle burns perfectly well in ordinary air; let us see whether it will burn in the air from marble. We introduce it; the flame at once goes out. From this we learn that ordinary substances, at any rate, will not burn in the gas from marble.

But chemists, as I told you on the last occasion, are acquainted not only with ordinary combustibles, but also with extraordinary combustibles. Zinc, magnesium, sodium, and iron, although not usually regarded as combustibles, are,

nevertheless, combustible in the eyes of the chemist; they have the property of burning in the air. Now this particular substance—sodium—not only possesses the property of burning, as ordinary combustibles do, in air, but it has also the property of burning in the gas from marble; and at the end of the last lecture, when heated in the gas from marble, this sodium not only burned with great brilliancy, but it produced a very extraordinary result. Here is the flask in which we performed the experiment, and we found in it a large piece of charcoal. Where did that charcoal come from? It did not come from the sodium, as we know, for this reason: you may treat sodium in all sorts of ways—burn it in the air, or in a variety of gases; but do what you will with it you cannot get any charcoal out by means of it, unless you employ some substance which, like the gas obtained from marble, contains charcoal; and we may not only get charcoal from the gas by means of sodium, but by a variety of other substances, and therefore we are led to the conclusion that the charcoal came from the gas of the marble, and that this gas or air evolved from marble contains charcoal as an essential constituent.

I have hitherto called this gas "air or gas from marble;" I ought to tell you that it was originally called "fixed air," because it is capable of being fixed or absorbed by lime. It is now called "carbonic gas," because it is the air or gas from charcoal or carbon. Marble, then, is a compound of quicklime with carbonic gas, and is called chemically "carbonate of lime."

The next thing to consider is whether, since we can get charcoal out of carbonic gas, we cannot produce carbonic gas from charcoal as well as from marble. First, let me explain to you the method of ascertaining the presence of this gas; the test used for this purpose is lime-water. The carbonic gas forms with the lime-water an insoluble compound—chalk—and accordingly, when we find that a gas passed through lime-water converts it into the insoluble substance chalk, we know that we are dealing with carbonic gas—the gas containing charcoal. Now let us see whether we can get any of our carbonic gas produced from charcoal. Here is a tube passing into some lime-water; we draw some of the air from this burning charcoal through the tube into the lime-water, and the lime-water, which at first was perfectly clear, becomes converted into a mixture of chalk and water. We convert the lime into chalk, a proof that we are dealing with that particular kind of gas which has the property of rendering lime-water turbid, and thus we know that by burning this charcoal we are converting it into carbonic gas.

Now, carbonic gas is produced not only by the burning of charcoal, but also by the burning of other ordinary combustibles. Here are some bottles, which in the ordinary acceptance of the term are empty; that is to say, they are full of air and nothing else, and would be called empty bottles. We will first hold one of these bottles over an ordinary gas flame, and then pour into the bottle a little lime-water; we shake it up for a minute or two, and you see our lime-water is converted into chalk, and, therefore, we find that ordinary gas has also the property of forming this carbonic gas or fixed air. We will now try another combustible—a piece of wood. We take a piece of wood in the same way, and allow it to burn inside the bottle, and notice whether, under these circumstances, we obtain this carbonic gas. We will add to it some lime-water, and we shall find that our lime-water in this case, as in the other, becomes milky from the formation of chalk, showing that not only charcoal and coal gas, but wood also, when burnt, has the property of producing this particular kind of gas which we obtain from marble. We will now take another combustible. We will take a taper and burn it in the same way in this other empty bottle, and notice whether any carbonic gas or fixed air is produced; we observe that here, also, our clear lime-water is converted into a chalky liquid. We find, then, that carbonic gas is thrown into the atmosphere by all ordinary burning bodies—by the burning charcoal, the coal gas, the wood, and by the taper.

Now, are there any other means by which carbonic gas is discharged into the atmosphere? One other is decay. You all know that in the autumn the leaves fall off the trees, and sometimes accumulate till they are up to your ankles, or even higher. I have not any decaying leaves to experiment with, but I have some rotten wood; and I want to show you that by this, and by the rotting of leaves, sawdust, and bodies generally, we get carbonic gas. Here is a tube in the shape of the letter U, containing some lime-water, and we will suck the air from this tube through the lime-water, and you will see that the rotting wood has the property of giving off this carbonic gas and rendering the lime-water turbid. Decaying leaves and decaying sawdust would do the same.

Another way in which this gas is also discharged into the atmosphere is by breathing. Here we will vary the experiment a little by putting the lime-water into the bottle first. I will shake up the lime-water to show you that there is nothing formed at present; I do not shake it very violently, or it would form a froth which you might mistake for the whitening of the liquid by the formation of chalk. I now breathe into the bottle, and shake up the contents as I did before; and you will observe that the soluble lime is at once converted into chalk.

You see, then, that this gas from chalk or marble is constantly poured into the atmosphere from endless sources—from all burning bodies, from all decaying bodies, and from all breathing animals. Now is there any other source? In various parts of the earth, more particularly in volcanic districts, we find that quantities of this gas issue from the earth with enormous force. Indeed, so great is the quantity, that it is probable that the amount of this fixed air evolved into the atmosphere from fissures in the earth, and from caves, and volcanoes, and sources of that kind, far exceeds that which is discharged into the atmosphere by all the fires, all the decay, and all the breathing animals on the surface of the earth. Now I cannot bring you any of this natural gas bottled up—at least, not very conveniently; but we find that it may be obtained in other ways. The gas which issues from the surface of the earth sometimes comes up in the form of gas; but sometimes we find water saturated with it—and this is the nature of the natural effervescing waters, such as the Seltzer, waters which is imported into this country in bottles, and of the Brighton, or artificial Seltzer water, which is made to imitate the natural water. In these waters a large quantity of the gas is condensed, and it is given off from them just as it is evolved from charcoal by burning it. We will put a screw tap into a bottle of Seltzer water, and see whether we can get any carbonic gas evolved. We turn the tap, and collect some of the gas which is given off, and we find that the gas evolved from Seltzer water is identical with the carbonic gas we have been considering. This illustrates one of the many natural sources of this gas.

You will perceive, then, that in consequence of the constant occurrence in nature of the actions which I have mentioned, the air by which we are surrounded must contain carbonic gas, and, as a natural consequence, charcoal. The invisible air by which we are surrounded really contains charcoal in the form of an invisible gas, and you would, perhaps, think that from the existence of so many natural sources of the gas, the proportion of carbonic gas in the air ought to be very large; but in reality it is extremely small—amounting to only half a part in a thousand; in fact, it is rather less than half a part, but I state it broadly that you may remember it. Now, I can give you some illustration of the quantity by means of an experiment. I have here a tube which contains this carbonic gas, and into the tube I put, not lime-water, but milk of lime—a mixture of lime and water, containing more lime than the water can dissolve. We now shake up the tube of gas, and then open it under water; we pour in some more of this milk of lime, and we shall be able by repeating this to dissolve the whole of this kind of air, which, you remember, is called fixed air, because lime has the property of fixing it. I close the end of the tube with my thumb, and shake up the lime with the air of the tube, and again open it

under water. You see, the water immediately rises to a considerable height in the tube, and if we continue to operate in this way the water will at last rise to the extreme top; this shows that the lime has the property of completely absorbing this gas. Now if we take this other tube, which only contains common air, and treat it in the same way, the quantity of carbonic gas in the ordinary air is so very small that you will not notice any absorption whatever. I close the tube with my thumb, and shake it up as I did the other, and then insert it under the water and open it, and you will observe that there is practically no absorption, or rather the amount of absorption is so small that you cannot notice it. It amounts to only half a part in a thousand.

Nevertheless, I can show you the presence of this gas in the air if I adopt certain means. I will take some lime-water, and introduce it into this tube in front of you. Here is a vessel, termed an aspirator, filled with coloured water; and if I turn the stop-cock, and allow the water to run out, you will observe that, as the water runs out, the air must be sucked through the lime-water to fill its place; and I dare say that by the end of the lecture we shall have drawn through the lime-water a sufficient volume of air to affect it and render it turbid.

The action is here going on in another way. In this dish I have placed some lime-water, which was originally perfectly clear and brilliant. If you look at it after the lecture you will see that it will be covered with a scum of chalk, due to the carbonic gas in the air of the room. In this way we find that carbonic gas, and consequently charcoal, is a constant constituent of atmospheric air.

I want now to consider how it is that this carbonic gas gets into the air—by what process charcoal is converted into carbonic gas, and how the air comes to contain it; and for this purpose it is necessary that we should again turn our attention away from charcoal, and consider for a few minutes the nature of air. I must here call your attention to some historical facts in connection with it. What sort of a substance is air?

The first point to which I want to call your attention is that air is a real material substance. At the commencement of my first lecture I told you that you had to come to the Royal Institution to learn about *things*—about things that could be touched and weighed. Now I am talking to you about air. Is air a *thing*—something that can be touched and weighed? Let us begin gradually; if we take a block of wood and press it between our hands, we find that it is sensible to the touch. This capability of being felt has received various names. Sometimes it is called "impenetrability," because one body cannot occupy or penetrate the space that is being occupied by another body; sometimes it is called "extension," because the body extends, between my hands for instance, and keeps them apart; and it is more commonly called "resistance," because the substance resists, as this wood does, my hands. Whether you call this property impenetrability, extension, or resistance, the word means the same thing. It means that the body is capable of being felt. A solid body, we know, is capable of being felt; but when we come to the case of sand, and when I press it between my hands, it does not keep my hands apart like the block of wood. Hence you might say at first sight that the sand does not possess this property of impenetrability or extension or resistance; but if we put the sand into a bag so that it cannot make way for my fingers, it then keeps my fingers apart, and resists the pressure of them just as the block of wood did, and so we must say that it has impenetrability. A tight bag of sand might be regarded almost as a hard solid substance; it is capable of striking a very heavy blow, and, indeed, was formerly used for that purpose. When we pass from such a substance as sand to a liquid substance like water, we find that it keeps the hands apart still less forcibly than the sand, and you may say that it is perfectly penetrable. Well, it is penetrable in one sense, but not in another. If I put water into a bladder, the water not being able then to make way for my fingers will keep them apart,

and that is what we call the capability of being felt—the property of impenetrability or extension. Again, we cannot, under ordinary circumstances, feel the air, but if the air is placed in a bag, like sand or water, we can feel it perfectly well. Here I have a bladder of air, and I can feel that there is something in it which my fingers cannot penetrate—which resists their pressure—which extends between them, and therefore we say that the air is possessed of this capability of being felt, which constitutes it a *thing*. But is it also capable of being weighed? Can we weigh air? I think we can. Here is a flask from which the air has been removed by a means to which I do not intend now to direct your attention. We place this flask on a balance, and it is now more than balanced by a weight on the opposite side, for the weight is heavier than the flask. I will let the air rush into the flask, and you will see under these circumstances that the flask will become heavier than the weight: at present the counterpoise is heavier than the flask. Now listen! [opening the stop-cock to admit the air.] You hear the air going in, and you see that the flask becomes heavier than the weight on the other side of the balance.

Not only is air possessed of weight, but it is really very heavy. A cubic foot of air weighs something between an ounce and an ounce and a quarter. You might think that we ought to be able to feel its weight, and here I will devote a few minutes to explaining to you the recognition of atmospheric air as a material substance. Thoughtful people in all ages have taken notice of the air, but there must have been a lapse of at least 2,000 years between the first scientific notice of the air and the discovery of the fact that the air was a thing or substance. It was not until the year 1643 that atmospheric air was recognised to be a substance possessed of weight and capable of being felt, so that, although the air is a weighty substance, yet its weight is not very easily appreciated. You are not yourselves conscious of its being weighty, and for 2,000 years after mankind had begun to think of it, and perhaps for as many years before, they were quite unconscious that it was a substance possessed of weight. They said that if it was weighty its weight ought to be perceptible. Now the reverse is the truth; if it is weighty you ought *not* to feel it. It would take me too long to explain this to you, so I will give you an illustration instead, and I want you all to see it. This is a large tube closed with a bladder; at present it is nearly full of coloured water, and it is quite obvious that the bladder has to support the weight of the water, and from this cause you see it becomes extremely taut, and shows unmistakable evidence of the water pressing upon it. If I lower the tube into this jar containing colourless water so that the water is as high outside as it is inside, you will see that the bladder becomes unconscious of the weight of the water. There is water as before, but still the water on each side is so exactly balanced that the bladder is no longer conscious of it. Now again, [lifting the tube out] the bladder is extremely taut; very likely a little more will burst it; but directly I lower it into the vessel so as to have the water level on the inside and on the outside of the tube, the bladder becomes perfectly flaccid and insensible to the weight of the water, just as we are insensible of the weight of the air by which we are surrounded. Take another illustration. In each of the pans of this balance is a pound weight, and the pans now perfectly balance one another. Under ordinary circumstances a feather would be quite incapable of raising a pound weight; but in this instance you will see that it will suffice to do so. If I take this feather in my hand and gently raise it under one of the pans containing a pound weight, it raises it up above the other; the reason of this is that the weight on one side is so exactly balanced by that on the other side, that the feather is not sensible of the weight it is moving. In the same way we are insensible of the weight of the air in which we live, because really that weight is not supported by ourselves, but by that of the surrounding air. So much, then, for the question of the weight of air.

The discovery of the weight of the air was made in

1643; from the year 1643 to the year 1756 mankind were of opinion that there was only one kind of air, although many of them knew that air could differ in some respects. They were aware, for instance, that the air of the town differed from that of the sea—that some air had different properties from other air; but they never recognised these different kinds of air as distinct substances. They rather looked upon the difference as being of a similar kind as that between different sorts of water. You know there are rain water, river water, sea water, and spring water; but all these consist essentially of the same substance—water—together with certain impurities. Well, from the year 1643 to 1756 mankind thought there was but one kind of air, and that the differences were due to impurities which gave the various airs a different character, just as sea water differs from common water because there is a little sea salt dissolved in it, and so on. In reality, however, there are essentially different kinds of air. First of all, we find that there are airs of different colours; here is some of a decidedly green colour; in this other bottle we have some of a brown colour—so that we are acquainted not only with colourless air, but with airs of different colours, just as we may have liquids of different colours; but when we recognise no difference by the colours of air, we may recognise them by other means. For instance, if I take a taper and introduce it into what we call an empty bottle—that is, a bottle containing ordinary air—the taper continues to burn perfectly well, but if I take it out of this bottle containing ordinary air, and insert it into this other bottle, we find that the taper is at once extinguished by our old friend, fixed air, or carbonic gas; and this was the first air discovered as differing from ordinary air. It was discovered in 1756, and it differs from ordinary air in containing carbon.

We will now take another kind of air, which is colourless, and looks like ordinary air; we will apply a light to it, and try what will be the effect—whether our light will continue to burn. [On the experiment being tried, the light was immediately extinguished.]

This, then, is a third kind called *azotic* air. Those of you who are Greek scholars will know that azotic air means lifeless air, and it was so called because it will not support life; it has also been called *phlogistic* air; it is now termed *nitrogen* gas, because it is capable of producing, or being produced from, nitre.

Here we have some air, which, when a light is applied to it, burns with a flame. This air was originally called inflammable air; it is now called *hydrogen* gas, because it enters into the composition of water.

You saw that when I introduced the taper into the azotic air, or nitrogen gas, the light at once went out. In this respect, then, azotic air behaves exactly like carbonic gas; but it differs from carbonic gas in this particular—that it is not capable of being fixed by means of lime-water. We will shake up some of this gas with lime-water, and you observe that the lime-water remains perfectly clear; whereas, if we had taken the bottle containing carbonic acid, the lime-water would have become milky, in consequence of the formation of chalk. Therefore this azotic air corresponds with the fixed air in not allowing bodies to burn it, but it differs from the fixed air in not rendering the lime-water turbid.

We now come to another kind of air. It was discovered in 1774, and was originally called *vital* air; we now call it *oxygen* gas. On introducing the lighted taper into this oxygen, we shall see whether the taper burns as in ordinary air, whether the gas takes fire, or what happens to the taper. We introduce it, and you see with what increased brilliancy the taper burns. This, then, is a fourth kind of air we are dealing with.

I will finally call your attention to a fifth kind of air, called *marsh* gas; this is an essential constituent of ordinary coal gas. You are all familiar with the appearance coal gas presents when it is being used in the ordinary way for lighting. You observe, when we set fire to this marsh gas, it at

once burns in a similar way. It was originally called heavy inflammable air, because it is much heavier than ordinary inflammable air, or hydrogen. Thus, you see, chemists are acquainted with a variety of kinds of air.

We will return to this fixed air, or carbonic gas, or gas from charcoal, and the way in which it gets into the atmosphere. And this leads me to make some remarks on the miscibility of different kinds of air with each other. I will illustrate this by reference to certain liquids, and first let me call your attention to this cylinder, at the bottom of which I have poured some of the heavy liquid mercury. Upon the mercury is the colourless liquid chloroform, which is also heavy; and then upon that some water, which I have coloured in order to make it more evident. Thus we have three different liquids in the cylinder, standing in layers one upon the other, and not capable of mixing. If I put a stick into them, and stir them up, they soon settle again into distinct layers. I can even pour upon the water another liquid—ether—and in this way we shall have four immiscible liquids together in the jar. Thus we have four liquids in the vessel—mercury at the bottom, chloroform next, then the coloured water, and the colourless ether at the top—four liquids which are not capable of mixing. There are, however, certain other liquids which are capable of mixing with each other, and I will now draw your attention to some of them. Here I have another cylinder, with some coloured liquid at the bottom and some colourless liquid at the top; the first is coloured water, and the other is spirit of wine. If I stir up these liquids, they mix, and will not again separate. Now here is a cylinder which looks at first sight as if it contained only one liquid, but, in point of fact, it contains two—water at the bottom and spirit of wine at the top; and I dare say I can render this evident to you. If I introduce into the cylinder a piece of wax, and allow it to drop gently into the liquid, you see it drops only half way; the wax drops through the spirit of wine, for it is heavier; but being lighter than the water, it floats on the top of it. In such cases, although the liquids are capable of mixing when one is lighter than the other, you may, by using care, put the lighter liquid at the top of the heavier one. Now, if I shake these together, we shall get a mixture of spirit and water containing so much water that the wax at once floats at the top. In point of fact, then, these liquids do not differ so much from one another with regard to their miscibility as the liquids to which I first called your attention. With regard to liquids, we find, then, that some will mix and others will not. With regard to gases, however, we found that all gases will mix; we can put one gas at the top of another, and keep it so for a short space, but after a time the two gases will mix completely. For instance, here is a brown-coloured gas. Now I can put on the top of this a cylinder of air, and we shall have in that way a colourless gas floating on the top of a coloured gas, just as we had a coloured liquid floating on the top of a colourless one; but you will observe that the brown gas will gradually mix with the colourless gas, even without much agitation.

We will now take another illustration, and one in which we shall be able to make a comparison similar to the floating of the piece of wax on the surface of the lower liquid. Here is a cylinder apparently empty, but in reality containing at the bottom of it some fixed air, and the upper portion of the cylinder is filled with ordinary air. Thus we have two colourless gases in that cylinder, just as we had two colourless liquids in the vessel we had before us just now. I shall be able to show you the point to which the lower gas rises. If we introduce into this cylinder a jet of burning gas, it burns perfectly well while in the air, but when we allow it to go a little lower it comes into the fixed air, and the flame is immediately extinguished. You see, then, that this jet of flame finds out the margin of the heavy and the light gas just as the wax found out the limit of the two liquids. Directly this flame is lowered into the carbonic gas it ceases to burn. You see, therefore, that you may have in the same cylinder two different airs floating one on the top of the other, just as you may have two liquids one on the top of the

other; but eventually you will find in the case of the gases that, whether they are in a state of agitation or in a state of rest, they will mix perfectly with each other.

Now comes the question,—is the ordinary atmospheric air with which we have to deal a single gas or a mixture of different gases? I might call your attention to a great many experiments illustrative of the fact, that ordinary atmospheric air is really a mixture; and here is one. You know that many metals have the property of rusting. Some of them rust very quickly, like iron, others of them rust very slowly; like mercury, copper, or silver. Now, if you take such a metal as iron, which rusts tolerably quickly, and put it into a confined space of air, the iron gradually rusts, and as it rusts the volume of air grows less and less until, in fact, the five volumes of air are reduced to four; now, this has taken place in the present instance. Here you have a cylinder which was full of air; some iron wire was put into it, and it has at last sucked up one-fifth of the air. Here, again, is a piece of phosphorus on the end of a stick, and this piece of phosphorus is rusting just in the same way. The phosphorus will go on rusting until the liquid in the cylinder rises up one-fifth, and then the rusting will entirely stop. We find, then, that one-fifth of the bulk of the air is capable of being absorbed by rusting iron and by rusting phosphorus, and also by burning phosphorus. We will take some phosphorus and burn it under a cylinder inverted over water. We dry a small piece of phosphorus on a piece of paper, and place it on a piece of cork, and burn it under the cylinder, and as it burns you will find that the water will gradually rise in the cylinder until it reaches one-fifth of the way up. [The experiment was performed with the result described.] Now, instead of burning a piece of phosphorus, I will in the same way burn a piece of candle also floating upon cork, and you will see, as before, that as the candle burns the water rises in the glass vessel.

I must defer further consideration of this property of different kinds of gas to mix with one another to my next lecture; but before I conclude I wish to show you two more experiments in illustration of my lecture.

First of all, I told you that air is a material substance. Here you have an illustration of it; here is a flask of coloured water inverted over what appears to be an empty bottle, and the neck of the upper flask communicates with the neck of the vessel underneath. Now why does not the water run out into this lower flask? Because that flask is *already full*. It is already full of air, and the air cannot get out, and therefore the water from the upper bottle cannot get in; but if I just for a moment allow the air to escape from the lower flask, the water will run in from the upper vessel. If I close the receiver, you see that in a moment or two the water ceases to run, because the air contained in the receiver cannot escape to make room for it.

The other experiment is one intended to illustrate the way in which air tends to magnify the appearance of some substances. Here we have a large glass jar which appears to be full of cotton wool. In reality cotton wool occupies a very small portion of the jar, which is filled chiefly with air. I dare say you will be surprised to find that the whole of the wool may easily be put into this cylinder which seems to be already almost full of spirit. [The smaller cylinder was of about one-eighth the capacity of the large cylinder containing the dry wool, and was nearly full of spirit of wine.] We will colour the spirit blue to make it visible to you all. [The lecturer then began to transfer the wool from the large jar into the small vessel containing the spirit; the wool so transferred was compressed at the bottom of the liquid by means of a glass rod. After continuing the operation for a short time the lecturer proceeded.] We have put a large portion of the wool into the cylinder, but the cylinder is not full; it is apparently no fuller than it was before, and if I put the wool in carefully I shall be able to go on until the whole of the wool is transferred.

LECTURE III.

AIR—OXIDES—CARBON OR CHARCOAL.

Unabsorbed four-fifths of original air known as phlogistic air, or nitrogen; its capability of supporting combustion and life—Recovery of absorbed one-fifth of air, by heating the rust of mercury—Proportion of ordinary air absorbed by rusting mercury, and evolved by ignition of the rust, known as vital air, or oxygen; its extreme power of supporting combustion and life—Reproduction of ordinary air by admixture of vital air, or oxygen with phlogistic air, or nitrogen—Formation of oxides by combustions of different substances in air or oxygen—Formation of arsenic acid or oxide, by combustion of arsenic; of carbonic acid or oxide, by combustion of carbon; of sodium oxide or soda, by combustion of sodium—Oxidation of carbon by its ignition with arsenious acid, and correlative deoxidation of the arsenic—Oxidation of sodium by its ignition in carbonic acid gas with correlative deoxidation of carbon of charcoal—Existence of carbon, or charcoal, in burnt or oxidized, and in unburnt or unoxidized condition—Presence of charcoal in any combustible shown by occurrence of carbonic gas, or oxide of carbon, as a product of its burning—Presence of hydrogen in any combustible shown by occurrence of water, or oxide of hydrogen, a product of its burning—Presence of both carbon and hydrogen in coal gas shown by occurrence of both carbonic gas and water as products of its burning—With deficient supply of air, preferential burning of the hydrogen of coal gas, and partial separation of its carbon—Separation, also, of the carbon of coal gas as a result of its ignition, or simple exposure to a red heat—Ordinary production of charcoal from wood, peat, &c., by the processes of partial burning and of ignition respectively—Unburnt carbon the characteristic constituent of vegetable tissue—Passage of unburnt charcoal from the vegetable into the animal and mineral kingdoms—Manufacture of animal charcoal, or bone-black, and of mineral charcoal or coke—Remarkable porosity of certain kinds of charcoal—Extraction from boxwood charcoal of many times its volume of air; absorption by boxwood charcoal of fifty-five times its volume of sulphuretted hydrogen gas, and ninety times its volume of ammonia gas; yet greater absorptive power of cocoa-nut shell charcoal—Chemical reactions on each other of different gases absorbed into charcoal—Absorption and aerial oxidation of putrefactive vapours by charcoal—Principle of charcoal ventilators, charcoal respirators, &c.—Absorptions of different colouring and odorous matter from solution by charcoal—Purification of water by charcoal filters, with destruction as well as absorption of impurities.

You will remember that when charcoal or carbon burns in air it is changed into carbonic gas; we have now to consider what is the nature of this change—what it is that happens to the charcoal, and what it is that happens to the air in which the charcoal burns.

In order to find out what occurs to the air we must first know a little more about the air, and particularly whether ordinary air, in which the combustion of charcoal and other combustibles takes place, consists of one kind of air only, or is a mixture of two or more different kinds. You will remember that all kinds of air are miscible with each other; in this respect they differ from liquids, and accordingly we have this morning to begin our consideration of the question whether air consists of one kind of air only, or of two or more different kinds. But first I want to direct your attention for a moment or two to an experiment which, as it takes some little time, I will now commence, and in half an hour we shall, perhaps, see the result.

Here I have an ordinary transparent glass tube, which is filled with pieces of broken white porcelain, and through this tube I am going to pass a current of ordinary coal gas. The coal gas is now passing through the tube; we will just let it blow out the air with which the tube was first filled, and then we will apply a light to it. Now you observe that the tube is filled, and that the gas burns in the ordinary way in which coal gas burns; gas is passing through the porcelain, but it does not now produce any effect. I am going to repeat this experiment with this difference—that the tube instead of being cold will be made red hot, and after the porcelain has been heated some time in the furnace we shall see whether it has undergone any change. [Near the close of the discourse, the lecturer again drew attention to this experiment, and pointed out that, under the influence of the strong heat which had been applied to the tube, the coal gas had deposited a portion of its carbon; the separation of the carbon being evidenced by the blackening of the porcelain.]

We will now proceed to the consideration of the nature of ordinary atmospheric air.

When a body—iron wire, for instance—rusts in the air,

this is the sort of thing that occurs. If you take five measures of air, and put the iron wire into them, they grow gradually less and less in bulk; a portion of the air becomes absorbed by the iron wire until a certain point is reached, when exactly one-fifth of the entire quantity of air has been absorbed, and when this has taken place, the rusting action ceases. The absorption goes on no longer, but the remaining four measures of air are of a very different character from the original five; metals will no longer rust in them, bodies will no longer burn in them, and animals will no longer breathe in them. Apparently, therefore, the whole of the gas which enables metals to rust, combustibles to burn, and animals to breathe, exists in the one-fifth of the volume of air taken up by the rusting wire.

Now let us pass to the burning of a body. If we burn, in a confined volume of air, some highly combustible substance, such as phosphorus or sulphur, the same thing takes place. The phosphorus goes on burning, and as it burns the volume of air gets less and less, until exactly one-fifth part of it has disappeared, and as soon as one-fifth is consumed the phosphorus is extinguished; it no longer burns, and we get exactly the same kind of air as in the other case. Of our original five volumes of air, we have four remaining, and in these, metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe. If, instead of burning a highly combustible body like phosphorus, we take one less so, such as a candle, we find that it is extinguished before one-fifth part of the air has been taken up; but if we then introduce some iron wire it will rust and take up a further portion of the air, and when the iron wire no longer rusts in it we shall find that the quantity of air taken up by the candle, supplemented by the remaining portion taken up by the rusting of the wire, amounts to exactly a fifth part of the original volume. Again, if we put a bird or a mouse into a vessel of air, it would go on breathing whilst our air became less and less, but it could not go on until it had entirely taken up the fifth part of the original air. These animals are, in this respect, in the condition of the candle; but if we take some slow-breathing animals, such as snails or frogs, and put them into a confined quantity of air, they will do exactly what the burning phosphorus does—they will go on breathing until they have consumed the fifth part of the volume of the original air, and they will leave four volumes of air of the same character as that left by the burning phosphorus, in which metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe.

Now comes the question—what is the nature of these remaining four volumes of air? Chemical experiments tend to prove that they are of the sort to which the Greek name of *azotic* or lifeless air was given. It was also called by another name, equally long, and far more barbarous—*phlogistic* air. It has also received the name of *nitrogen* gas, by which it is generally known. Here is a bottle of nitrogen; we introduce into it a lighted taper, and it is immediately extinguished.

Now is it possible to recover this one-fifth part of the air which has been absorbed? Yes, it is; and it is interesting to note that the particular experiment by which the composition of air was first ascertained by Lavoisier is the same which still best serves to exemplify its composition. I have spoken to you about the rust of iron. Chemists are acquainted with a great number of metals, and in particular with that metal which you see in this bulb, and which you know as quicksilver or mercury. It is a very peculiar metal, and the only one which is in a liquid state at the ordinary temperature. You know that lead, for instance, is solid at the ordinary temperature, but it will become liquid upon being heated, and even iron and gold when very intensely heated also become liquid. Mercury, however, is hot enough at common temperatures to exist in the liquid state, and it is the only metal with which chemists are acquainted that is so. At the ordinary temperature, whether in summer or winter, and in any climate, mercury does not rust. It only rusts when heated, and then it does so very quickly,

and meanwhile maintains just the same sort of action as the iron does. As it rusts it absorbs one measure out of the five measures of air, and we obtain, as the result, a quantity of the rust of mercury, which is a red substance not unlike the rust of iron. This bottle contains some of it; it was made by rusting mercury in heated air.

There is another point of interest in connection with this rust—If you go on heating it still more strongly the mercury which had become converted into rust, makes its appearance again in the original state, and at the same time a quantity of air or gas is given off, the peculiarity of which is that the amount of gas so evolved is exactly the quantity of air or gas which the mercury absorbed in rusting; so that if you take five measures of air and heat the mercury in them, and so absorb one measure, and then take the rust of mercury so produced and re-heat it, you recover exactly the one measure of air which the mercury originally absorbed. Here is the experiment arranged in this small tube. We have in the tube some of the rust of mercury. We will heat it rather strongly, and in the course of a little while we shall find that it will break up into the original mercury, and into a certain quantity of air or gas, which, in a few minutes, we will collect in this receiver, in order to ascertain its nature. This substance will take some little time in becoming sufficiently hot, because, after it is heated to the temperature at which mercury rusts, it must be heated to a degree beyond, that it may undergo this decomposition into the original mercury and into the gas. [After an interval]—Our decomposition has taken place in the tube. The vital air is now being given off by the action of heat, and in the upper part of the tube we have the mercury in a separated state. I will just show you what is the nature of the air which we have in our tube—even this small quantity will suffice for our purpose. We introduce a match into this vessel, and you see how very brilliantly it will burn in the vital air from the rust of mercury.

We will now consider what are the properties of this particular kind of air; it has *this* property—that if you take the one measure of air which the mercury first absorbed in order to rust, and add it to the four volumes of air that remain, you get exactly the quantity with which you started—viz., five volumes; and more than that, these five volumes so formed are undistinguishable, by any means whatever, from the original air with which you began the experiment. Now you will remember that this nitrogen—this residual air—is a kind in which bodies will not rust, nor combustibles burn, nor animals breathe. The breathing capabilities all lie in the one-fifth part which becomes absorbed. Then comes the question, what name shall we give to this one volume upon which the breathing power of animals is exercised? It was originally called *vital air*—and formerly all these different kinds of gases were called *airs*; this *vital air* is now known as *oxygen gas*.

Now, from what we have observed in the experiments which have been explained to you, we learn that atmospheric air is a mixture of four volumes of phlogistic air or nitrogen, with one volume of vital air or oxygen; at any rate, this may be taken as about the proportion between the two. It is not exactly correct; the actual figures are—79 parts (instead of 80) of nitrogen, and 21 parts (instead of 20) of oxygen, to make up 100 parts of ordinary atmospheric air; this, then, is the composition of the atmosphere.

I will now proceed to direct your attention to some of the properties of oxygen. You will remember that in my former lecture I called to your minds the fact that, in addition to ordinary combustibles, such as candles, coals, and gas, chemists are in the habit of regarding different metals as combustible bodies; and I showed you how magnesium and zinc might be burnt in air. Now I wish first to direct your attention to the manner in which iron may be burnt in air, and then to the way in which it may be burnt in oxygen.

We will first burn some iron in air, and for that purpose we must employ a current of air, and also have our iron in

a very fine state of division—viz., in filings; for you know that iron in a large mass, such as a poker, will not burn in air, but in the state of filings you will see that it will do so, and with very considerable brilliancy. [Steel filings were showered upon a large flame from a gas blowpipe, and burned with their well-known star-like effect.] You see that in this way iron may very readily be burnt in ordinary air. Now I want to call your attention to the very different manner in which it burns in oxygen gas. When we burnt it in the air it was in the form of filings, but we can burn it in oxygen in a much larger mass. We take just such a flame as we had in the last experiment; but, instead of it being supplied with a current of air, as the other was, it is supplied with a current of oxygen gas, and in this we will now try to burn a piece of iron. For this purpose, we will take an old knife, and see what will happen. [A portion of the knife-blade was speedily consumed in the flame, and the combustion was attended by copious scintillations.] Well, you see it is very fortunate (if the expression is a correct one in such a case) that our atmosphere does not consist entirely of oxygen; for if once these knives got thus heated they would burn almost entirely away, and we should have none for use. So much, then, for the manner in which bodies burn in oxygen gas compared with the way in which they burn in ordinary air.

We will now endeavour to burn another metal in oxygen, and it is one with which you are not quite so familiar. There is a piece of metal in this tube; we apply heat to the tube, and the metal will very soon be hot; you will then see it burn in the oxygen gas which we now pass through the tube. We will have the lights lowered that you may see the very beautiful appearance it presents when burnt under these circumstances. It is just beginning to take fire, and now you see it burning with great brilliancy. The metal upon which we are now experimenting is arsenic, and by burning it we have produced a compound of the metal with the oxygen in which it burned, and this compound is oxide of arsenic, or the ordinary white arsenic of the shops. Now, having burnt this substance—arsenic—we are next going to do the same with charcoal. We have some in this dish, and the first thing we must do is to ignite it. You remember that when charcoal burns in oxygen it forms carbonic gas, and this carbonic gas is an oxide of carbon, just as the white arsenic which we formed by burning arsenic in oxygen was an oxide of arsenic.

Now, if instead of burning the charcoal in oxygen, we burn it in the white arsenic, the oxygen, under those circumstances, would leave the arsenic in order to burn the charcoal. The charcoal is burnt into carbonic gas, and the white arsenic is correspondingly unburnt into metallic arsenic. Here is the experiment already performed. We had here a mixture of white arsenic and charcoal; the charcoal took away the oxygen from the arsenic, and burned in that oxygen, consequently the arsenic is deposited in a metallic state in the form of this black ring.

I will now show you the combustion of one other metal in oxygen—sodium—and while it is burning I will again have the gas-lights lowered, and ask you to look at the appearance which the various colours upon this diagram exhibit when they are illuminated by the sodium light; and now compare the appearance of those colours under the sodium light with their present aspect in the bright light afforded by the burning of the metal magnesium. Now, when the sodium burns in oxygen it forms soda, or oxide of sodium. What then takes place with the sodium, when instead of burning in pure oxygen, it burns in carbonic gas? Just what I showed you in the first lecture. It burns in the oxygen which is already combined with the carbon; it takes away the oxygen from the carbon, in this way setting it free, just as when the charcoal burnt in the oxide of arsenic it took away the oxygen of the oxide of arsenic, and set free the arsenic in the metallic state.

(To be continued.)

FOREIGN SCIENCE.

PARIS, DEC. 30TH, 1868.

Kreatinine, an index of putrefaction.—The bleaching of wood pulp.

AN index of the commencement of putrefaction in many animal substances may possibly be found by the presence of kreatinine. In a note on the presence of this body in putrefied whey, M. Commaille, among other interesting things, mentions the above fact. Some filtered whey was placed in a flask, simply covered with paper, and set aside for about a year. The whey fermented and then putrefied; numerous microzymas made their appearance, and the liquid became coloured a deep brown. Afterwards, the animal life gave place to a thick mass of spores; the foetid odour was succeeded by a musty odour only. The liquid thus altered was filtered, evaporated on the water-bath, and treated with alcohol of 85°, which became strongly coloured. This alcoholic solution was evaporated, and the residue treated with alcohol of 90°, which removed a portion; the substances obtained from the evaporation of the alcohol of 90° were divided by alcohol of 95°. That portion undissolved treated with water gave abundant crystals containing much mineral matter. Calcined, these crystals leave a white and saline ash; treated, after solution, with nitrate of silver they yield a voluminous precipitate which cedes to boiling water a small quantity of long needles, which are perhaps nitrate of kreatinine. The portion removed by alcohol of 95° furnishes, upon evaporation of the liquid, numerous crystals, which, under the microscope, appear as rectangular plates. These crystals are soluble in water and alcohol, insoluble in ether; they react as follows:—with nitrate of silver, a white magma, soon resolved into silky needles of double nitrate of silver and kreatinine; with syrupy chloride of zinc, small masses, which, examined under the microscope, appear as fine needles in radiating groups; these crystals are double chloride of zinc and kreatinine; with recently precipitated bin-oxide of mercury, at ebullition, metallic mercury. The kreatinine thus obtained is far from pure. Kreatinine ($C_4H_7N_3O_2$) occurs in the purified whey from the dehydration of the kreatine ($C_4H_9N_3O_2 \cdot 2HO$) already present in the milk. Urine, which has been exposed to the air for some weeks, contains no longer kreatine, but only kreatinine. It would thus seem that the small quantity of kreatinine found in beef tea and recent urine indicates an alteration, inappreciable, one may add, by other means. Kreatine is, in fact, much more often found in fresh animal substances, than kreatinine. The reason that kreatine has not been found in milk is probably the great amount of other materials present with it; and only when the lactine has been destroyed by fermentation and putrefaction, it becomes easy to detect in the whey the derivative kreatinine. The detection of a substance hitherto considered excrementitious in milk is worthy of remark. A further analogy between milk, blood, and meat is also established.

A process of bleaching wood pulp has been made known by M. Orioli. He has recognised (1) that chloride of lime, however little in excess, has a tendency to produce a yellow tint; (2) that all the strong acids turn the paste red under the action of the sun, or in some time without sunlight, in the presence of moisture; (3) that the slightest trace of iron is sufficient to blacken the paste in a very short time. These objectionable results are obviated by the following mixture:—For 100 kilogrammes of wood pulp 800 grammes of oxalic acid are employed, this serving the double purpose of bleaching the colouring matter already oxidised and of neutralising the alkaline principles favourable to oxidation; 2 kilogs. of sulphate of alumina, perfectly free from iron, are added. The principal agent in this new bleaching process is the oxalic acid, the energetic action of which on vegetable colouring matters is well known. The sulphate of alumina added does not bleach of itself, but it forms with the colouring matter of the wood a nearly colourless lake, which enables the brilliancy of the product to be heightened.

PARIS, JAN. 13TH, 1869.

Reagent for Alkaloids.—Purification of Bisulphide of Carbon.—Detection of Strychnine.—Crystallisation of Glycerine.—Detection of Mercury in Poisoning Cases.

THE double iodide of cadmium and potassium has been proposed as a reagent for alkaloids by M. Marmé.

This compound precipitates the following alkaloids from very dilute solutions mixed with sulphuric acid:—Nicotine, conicine, piperine, morphia, codeia, thebaine, narcotine, narceine, quinine, quinidine, cinchonine, strychnine, brucine, veratrine, berberine, atropine, aconitine, and some others. The precipitates are white and flocculent, but for the most part become crystalline. Quinine and strychnine, diluted with 10,000 parts of water, are entirely precipitated. These precipitates are insoluble in ether, soluble in alcohol, slightly soluble in water, and soluble in an excess of the double iodide. By agitation with a suitable solvent and the subsequent addition of alkali, the alkaloids may be separated. The double iodide of cadmium and potassium does not precipitate glycosides (amygdaline, salicine, saponine, digitaline, phloridzine, &c.).

M. Millon publishes a note "On the Purification of Bisulphide of Carbon." The sulphide of carbon is first washed several times with distilled water, as in the purification of ether, and then transferred to a retort of large capacity containing quick lime. After twenty-four hours' contact the sulphide is distilled off from the lime and received in a flask partially filled with copper turnings, previously roasted to remove all traces of fatty matter, and afterwards reduced by hydrogen. The lime remaining in the retort is strongly coloured. All the disagreeable odour of ordinary bisulphide of carbon is removed by this treatment, and when the nose is placed close to the mouth of the receiver an ethereal odour is only perceived. With bisulphide of carbon thus purified MM. Millon and Commaille have separated the perfume of the most delicate flowers, and even the perfume of milk to the extent of recognising certain plants eaten by the cow, the *Smyrniolum olusatrum* among others.

To detect the presence of strychnine in cases of poisoning M. Cloetta counsels the following treatment:—Any albumen which may be present in the liquid is first removed, subacetate of lead added, and the liquid filtered; the excess of lead is removed by sulphuretted hydrogen, another filtration made, and the filtrate evaporated to dryness. The residue thus obtained is left in contact with ammonia for twenty-four hours, then agitated with double its volume of chloroform, and the chloroformic solution evaporated; this residue is dissolved in 2 c.c. of water containing pure nitric acid, the solution filtered, and to the filtrate a drop of solution of bichromate of potash added. At the end of a few days crystals of chromate of strychnine appear in which the chemical characters of strychnine may be recognised. M. Cloetta affirms that, by his process, he has been enabled to prove the presence of 1-20th grain of strychnine in 650 c.c. of urine.

M. Werner has made some experiments on the crystallisation of glycerine. He was not able to form crystals by agitation or by cold. As he had recognised the presence of chlorine in some solidified glycerine, he made the experiment of passing a few bubbles of chlorine through glycerine of commerce, and, under these circumstances, small octahedral crystals were obtained possessing great hardness, but deprived of the sweet taste of glycerine even when melted.

The following is a method of examination for detecting mercury in poisoning cases, described by M. Buchner. This method was employed by M. Buchner in searching for mercury in the remains of a person poisoned by corrosive sublimate. The organic remains having been disintegrated by a hot mixture of chlorate of potash and hydrochloric acid, the solution was diluted and saturated with sulphuretted hydrogen. After the lapse of some hours the sulphide formed was collected, dissolved in aqua regia, and reduced by evaporation to a small volume. A little water being added, a bright piece of copper wire is placed in the liquid, and when mercury is present, the wire becomes grey, at the

latest, in two days. The copper is withdrawn, dried between folds of blotting paper, and heated in a wide test tube. The mercury is more easily distinguished by removing the wire, and placing in the tube a drop of tincture of iodine. M. Riederer, having remarked that the sulphide of mercury which is formed by this process always contains organic matter, has recourse to dialysis. He operates in the following manner. After disorganisation by chlorate of potash and hydrochloric acid, the mercury in solution is precipitated by sulphuretted hydrogen, the sulphide collected dissolved in a mixture of chlorate of potash and hydrochloric acid, and dialysed with 500 c.c. of water; at the end of five days the water is evaporated and the dialysis repeated. After this treatment the solution is again saturated with sulphuretted hydrogen; the precipitate is washed with ammonia and sulphide of ammonium, then with weak nitric acid, and finally treated afresh with hydrochloric acid and chlorate of potash. Operating upon dogs with calomel, M. Riederer has recognised that the greater part of the mercurial compound is eliminated by the excrements, and that for the rest, more collects in the liver than in the muscles.

PARIS, JAN. 20TH, 1869.

Estimation of Urea—Experiments with Sulphuretted Hydrogen—Patent for the Extraction of Iodine—Bleaching of Tissues.

SEVERAL errors are introduced in the estimation of urea when the nitrate of mercury used is prepared by acting upon the metal with nitric acid, the acidity of the titrated solution is variable, and the whole of the compound is not in the condition of mercuric nitrate. M. Byasson makes use of the following modification of Liebig's method:—Exactly 36 grammes of red oxide of mercury are weighed, and dissolved in 50 grammes of ordinary nitric acid diluted with half its weight of water; the solution is gently evaporated until acid vapours appear, and made up with distilled water to the volume of 1 litre, at about 15° C. If the dilution with water should cause a slight turbidity, a few drops of acid will render the solution clear. In this way a solution is obtained in which all the mercury is present as mercuric nitrate, and as little acid as possible. A test solution of urea is prepared by dissolving 20 grammes of crystallised urea in 1 litre of distilled water; 1 c.c. of the mercurial solution already made should correspond to .005 grammes of urea. During the process, M. Byasson makes use of a solution of 25 grammes of potash in 1 litre, from time to time, to partly neutralise the acid set free; the urea solution must never be rendered alkaline. The potash solution indicates the completion of the reaction, by forming a yellow precipitate on the surface. M. Byasson's results with this process agree remarkably well.

M. Böttger has made known the following experiments to be realised with sulphuretted hydrogen. A jet of this gas inflames by contact with teroxide of thallium, peroxides of manganese and lead, as well as with the peroxide of silver, obtained in powder by a battery. Many chlorates, iodates, and bromates behave similarly. Other compounds occasion a violent explosion, among these acetylide and fulminate of silver and iodide of nitrogen.

A patent has been granted to M. Lauroy for a new method of extracting iodine, and treating salts derived from kelp. When the lixivium has been freed from the less soluble salts, and concentrated to a density varying between 44° and 55° Baumé, it may contain free alkali, carbonates, sulphides, sulphites, and hyposulphites of alkalies, as well as alkaline iodides and bromides. The treatment varies, according as it is desired to separate the salts contained, or to extract at once the iodine and bromine. When it is desired to extract the iodine and bromine at once, the liquid is saturated with hydrochloric acid; the deposit which forms is separated, and the gaseous mixture which is evolved in the reaction of nitric acid on organic matters (as in the preparation of oxalic acid, picric acid, &c.) introduced. When these gases are principally formed of bioxide of nitrogen, a quantity of air is

admitted. The application of the nitrous gases may be made in several ways—sulphuric acid, in which nitrous gases have previously been dissolved, may be added to the liquid, or when the liquor contains sufficient alkali, nitrous acid may be admitted as long as there is absorption, and any acid whatever added afterward to precipitate the iodine. In whatever way one operates the precipitation of the iodine is determined by the reaction of the nitrous compounds. The precipitation is complete, and the bromine not set at liberty. When the iodine has been thus separated, the mother liquor is submitted to treatment, and the bromine extracted by the ordinary methods.

Before giving an abstract of a memoir entitled "Researches on the Bleaching of Tissues," your correspondent would remark that the author is M. Kolb, not M. Kolbe. In the rough fibre of flax, there exist, along with cellulose, two distinct substances—the one, pectic acid, is abundant, and possibly completely eliminated by alkalies; the other is a colouring matter which is developed in the steeping. This substance tints the fibre grey, and resists alkalies, as well as all ordinary chemical solvents. It may be isolated by M. Péligot's ammoniacal copper solution. While the pectic products are abundant (15 to 36 per cent), the amount of the grey matter is infinitesimal. Chlorine water and dilute solutions of the hypochlorites decolorise this substance without dissolving it. After decoloration it is still insoluble in alkaline solutions, which remain colourless. When the three constituent parts of the fibre are separately submitted to the action of chlorine water, the following is the result:—(1) the grey matter alone is decolorised by very weak chlorine water; (2) in slightly stronger chlorine water the cellulose is disintegrated and then attacked, gradually passing into water and carbonic acid; (3) the brown pectic products are only decolorised by decomposition in very much stronger chlorine water, and long after the alteration of the cellulose. From this it results that, in bleaching, chlorine is necessary for the destruction of the grey colouration, while this reagent must not be reckoned upon for removing the yellow tint. Theoretically, perfect bleaching is reduced to two operations—(1) removal of all yellow colouring matter by rigorous exhaustion with alkalies; (2) oxidation, which simply decolorises the grey matter, but without rendering it soluble in lyes, as hitherto supposed. Chlorine water, oxygenated water, and ozone, dry or humid, effect bleaching; but is this phenomenon due to an absorption of oxygen by the colouring matter, or to a removal of hydrogen? Experiments show that there is absorption of oxygen. Chlorine water can only be employed without danger very dilute, and at the greatest strength marking 10 chlorimetric degrees. Oxygenated water only attacks the cellulose when very concentrated. With equal strengths, and immersion for the same time, chlorine has a much more destructive action, and, at the same time, a smaller bleaching power, than oxygenated water. In the same conditions, a solution of hypochlorous acid bleaches better, and alters infinitely less, than chlorine water; it is, to some extent, an intermediate term between chlorine water and oxygenated water. Chloride of lime may be employed in three different ways in bleaching—viz., with hydrochloric, with carbonic acid, and simply in contact with the oxidisable matter. Of the three, the latter is the most rational, and presents most security. With regard to antichlors frequently employed, such as hyposulphite of soda, MM. Fordos and Gélis have demonstrated that if these substances remove, on the one hand, all trace of chlorine, on the other they favour the formation of acids pernicious to the cellulose. M. Kolb proposes to replace them by dilute ammonia, which acts first as antichlor in producing nitrogen and chloride of ammonium, and, further, removes, at the same time, all trace of acid from the tissue.

Certain fibres, perfectly bleached to all appearance, take, after a time, a yellow shade; this is only the case with those which have not been completely deprived of their pectic matters. M. Kolb has found ammonia in this respect a valuable reagent for detecting at once the possibility of this result

taking place. All fibres which have been bleached and rigorously deprived of pectose may be plunged in ammoniacal water with impunity; but if the exhaustion with lyes has not been complete, an amber tint will be immediately communicated.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

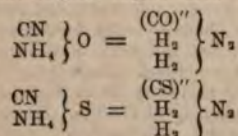
Thursday, December 17, 1868.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

THE minutes of the previous meeting having been read and confirmed, and the usual lists of donations and of visitors having been announced, the following certificates were read:—For the first time—Mr. J. J. Field, Highgate, Mr. H. W. Kearns, Accrington, Mr. E. L. Barret, 44 Lawford Road, London; for the second time—Mr. F. W. Hart, Mr. E. K. Muspratt, Mr. S. Williams, Mr. J. F. Allen; for the third time—Mr. T. Rowan, Mr. W. W. Stoddard, Mr. J. Hughes. The three last-named gentlemen were then balloted for and were duly elected.

The SECRETARY then read a paper "*On the Isolation of the Missing Sulphur Urea*," by J. Emerson Reynolds, Member of the Royal College of Physicians, Edinburgh, Keeper of the Minerals and Analyst to the Royal Dublin Society, &c.

Just as cyanate of ammonium under the influence of heat yields urea, so sulphocyanate of ammonium under similar circumstances should yield sulphur urea—



The probability of this reaction induced Liebig, Vöckel, and some other chemists to study the action of heat upon the sulphocyanate, but the results did not agree with their expectations.

More recently Dr. Hofmann* described a number of substitution derivatives of sulphur urea, but he did not succeed in isolating the urea itself. He appears to have regarded sulphocyanate of ammonium as the true sulphur urea, in spite of its saline constitution.

The author, in considering the points of similarity and of difference between the cyanate and sulphocyanate of ammonium, became convinced that the greater stability of the latter compound was the chief bar to its molecular rearrangement.

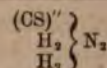
The temperature of 100° C., which effects the conversion of the cyanate into urea, has no effect upon the sulphocyanate, which, however, decomposes easily at a temperature above 180° C. The author therefore tried the effect of a regulated temperature upon the latter salt, and was rewarded by the isolation of the missing sulphur urea. He proceeded in the following manner:

About 500 grammes of the well-dried salt were heated to 170° C. for two hours by means of an oil bath, the author remarking incidentally that the true fusing point of the salt was found to be 159° C., instead of 147° as usually stated.

The mass was allowed to cool to 100° C., and was then treated with its own weight of water at 80° C. When the whole was dissolved, the liquid was filtered through a plug of cotton wool for the purpose of separating a small quantity of black substance, and was then allowed to stand until an abundant crop of fine long silky prisms of the new compound had formed.

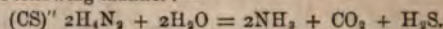
After several recrystallisations from the boiling water, the urea was obtained in a state of purity, and gave on analysis numbers which led to the formula—

* *Proc. Royal Soc.*, ix., 274.



Some difficulty was experienced in the determination of the carbon in consequence of the large proportion of nitrogen and sulphur present. It was found advantageous to introduce into the combustion tube, after filling with chromate of lead in the usual manner, a porous copper rod, prepared by rolling fine gauze so closely as to leave no central tube. This rod was heated, first in air and then in hydrogen, in the usual way, and was then made to fit closely into the combustion tube. It was found to reduce completely the nitrogen oxides formed during the combustion.

The new substance crystallises in long fine needles or in short thick prisms, in either case belonging to the trimetric system. It is non-deliquescent in moderately dry air, is very soluble in water and alcohol, and sparingly so in ether. The solution froths slightly on agitation, has a neutral reaction, and a somewhat bitter taste. Heated with water in a sealed tube for some hours to 140° C., it is reconverted into sulphocyanate of ammonium, as may be shown by the iron test. The urea does not give a colour reaction with the test. Heated with hydrate of potassium in a sealed tube, it is decomposed in the following manner:—

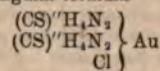


Hydrochloric and sulphuric acids effect a similar change.

The substance fuses at 156° C. Heated to a higher temperature in a closed tube it evolves sulphide of ammonium, carbonic disulphide, and ammonia; the mixture blackens, a yellow oil distils over, and a white mass remains which strongly resembles Liebig's hydromellone.

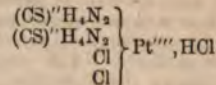
A beautifully crystallised nitrate of the new urea was prepared by treating the strong aqueous solution with nitric acid of sp. gr. 1.25. Its formula was found to be (CS)''H₄N₂.HNO₃. No hydrochlorate nor oxalate could be obtained.

Gold Compound.—On treating a saturated aqueous solution of the urea with neutral perchloride of gold, a reddish precipitate appeared at first, which quickly dissolved, when a yellow colour appeared in the liquid; it was slowly evaporated and yielded pearly monoclinic crystals, to which the author assigns the singular formula—

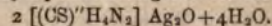


When the gold solution was employed in excess a very unstable compound was produced, which appeared to differ from the former one in containing only 1 equivalent of the urea and 2 of chlorine.

Platinum Compounds.—By methods analogous to the preceding, several platinum compounds were procured. For the most characteristic of them the author obtained the following formula:—

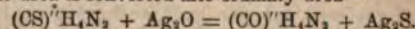


Silver Compound.—The action of nitrate of silver on the urea yielded silky crystals having the formula—



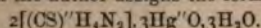
This compound is decomposed by heat with slight explosion, sulphide of silver and a crystalline sublimate being formed.

When sulphur urea and hydrate of silver are heated with a little water for half-an-hour, sulphide of silver is formed, and the urea is converted into ordinary urea—

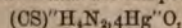


It is, therefore, probable that in the little-known process for the preparation of carbamide by the action of oxide of silver on sulphocyanate of ammonium, there are really two stages—one in which sulphur urea is formed, and one in which it is converted into ordinary urea and sulphide of silver.

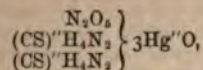
Mercurial Compounds.—A crystalline compound was obtained to which the author assigns the formula—



But it appears probable that the compounds—

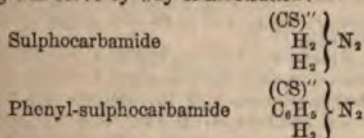


and



are likewise produced in some reactions.

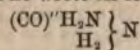
All ureas previously obtained possess more or less strongly marked basic properties, and the author believes that the new compound is the first instance known of a urea which manifests strongly marked acid and feeble basic properties. It follows from this investigation that the new compound is the true sulpho-carbamide, the primary of the series of compound sulpho-ureas discovered by Hofmann, and that sulpho-cyanate of ammonium must be regarded as the strict analogue of cyanate of ammonium. The author gives a list of Hofmann's compounds, and points out how simply they all relate themselves to sulphur urea. The following will serve by way of illustration:—



The author concludes by predicting the formation of sulphur-urea by the action of heat on sulphocarbamate of ammonium. Such a reaction would be perfectly parallel with that by which Bassaroff produced urea, namely, by the dehydration of carbamate of ammonium.

The PRESIDENT remarked upon the great beauty and simplicity of the primary reaction effected by the author.

Professor ODLING had no observations to make in direct discussion of the subject of the paper, but its close connection with urea tempted him to make a few remarks on the interesting theoretical question of the constitution of that compound. The current belief at present was that urea was identical with carbamide, and some facts were strongly in favour of this view; but, as he had pointed out some time ago, other facts were discordant, and Messrs. Wanklyn and Gamgee had lately, from experiments of their own, proposed a perfectly different formula for urea. There was a fundamental difference in the two views, and, in fact, we could not as yet say that we know the mode in which the carbon of urea was connected with the nitrogen. In addition to these two views a third had been suggested by Professor Kolbe, which, like everything that fell from his lips, was entitled to the most respectful consideration of chemists. Kolbe maintained that urea was not carbamide, but an amide of carbamic acid, and he wrote its formula thus:—

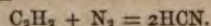


It appeared, however, to the speaker, that this was but a variation in the mode of writing the formula. He found himself unable to perceive how the amide of carbamic acid could be a different substance from carbamide. Possibly some disciple of Professor Kolbe—and most likely some were present—could point out where the difference lay.

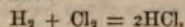
Professor WANKLYN had nothing to add to the arguments which he, in conjunction with Mr. Gamgee, laid before the Chemical Society on a former occasion. He believed that urea was not carbamide, because he found it wanting in some of the common reactions of the amides.

As there was no further business before the Society, Sir Benjamin Brodie, whose re-appearance after a somewhat lengthened absence was cordially hailed by the President and Fellows, drew the attention of the meeting to a very remarkable paper by Berthelot, published in the last number of the *Comptes Rendus*. Berthelot had subjected a mixture

of acetylene and nitrogen to the action of the electric discharge, and had thus, by a direct union of radicals, formed hydrocyanic acid—



Nearly the whole of the acetylene employed combined with nitrogen, and the reaction might be said to be strictly analogous to that in which hydrochloric acid was produced by double decomposition—



The meeting then adjourned until January 21, 1869.

Thursday, January 21, 1869.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

THE minutes of the previous meeting were read and confirmed, the donations to the library were announced, and the following certificates read:—For the first time—Mr. E. D. Holditch, Mr. W. Rossiter, Mr. A. K. Howard; for the second time—Mr. E. L. Barret, Mr. J. J. Field, Mr. H. W. Kearns; for the third time—Mr. J. F. Allen, Mr. E. K. Muspratt, Mr. F. W. Hart, Mr. S. Williams. The Society then proceeded to ballot for the four last-named gentlemen, and they were declared duly elected.

The SECRETARY (Dr. Odling) announced that at the next meeting of the Society a lecture would be delivered by Dr. Wallace, "On the Chemistry of Sugar Refining;" Mr. Tomlinson had promised to give a lecture at one of the March meetings, "On Catharism, or the Influence of Chemically Clean Surfaces;" Professor Williamson had likewise promised a lecture; and the council hoped that Mr. Lowthian Bell would do the same.

The first paper was then read by the Secretary (Mr. Vernon Harcourt); it was entitled—"On the Chemical Composition of *Canaüba Wax*," by Nevil Story Maskelyne, M.A. This wax is the product of a palm—the *Copernicia cerifera*—known to the Brazilians as the *Canaüba* tree. The glaucous coating which protects the younger leaves contains the wax in the proportion of about 50 grains to the leaf. It is collected and melted into a mass, and in this state constitutes a pale yellow or greenish body, somewhat harder and less resinous than the wax yielded by the noble palm of the Cordilleras. Its specific gravity is 0.99907, its melting point is 84° C., and it yields 0.14 per cent of ash. The crude wax was saponified by boiling with alcoholic solution of potash containing one-sixth of its weight of alkali, until the liquid became clear. The alcohol was then distilled off, and the residue thrown into a solution of neutral plumbic acetate, which produced a yellow colour. The liquid was evaporated to dryness, powdered, and extracted with ether, which removes the wax alcohols. By repeated crystallisations from ether, one of these alcohols, which appears to be melissin, was obtained in a state of purity. The insoluble lead-salt was afterwards decomposed by hydric chloride. In another experiment the wax was saponified as before, the alcohol distilled off, and the acids set free by hydric chloride. The mass thus formed was dissolved in boiling alcohol, the acids saturated with ammonia, and then thrown down by boric chloride. The alcohol was now distilled off, the mass was thoroughly exhausted with water and alcohol, and the residue reserved for an examination of the acids. The alcoholic extract was digested with ether, and after repeated recrystallisations a body was obtained having the properties of, and corresponding in percentage composition to melissin, $\text{C}_{21}\text{H}_{44}\text{O}$. To determine its constitution, it was converted, by heating to 270° with potash-lime into the corresponding acid. This acid, when very carefully purified, was highly electrical; it melted at 91°, and only dissolved in alcohol with the greatest difficulty. Its analysis agreed with the formula of melissic acid—viz., $\text{C}_{21}\text{H}_{42}\text{O}_2$ or $\text{C}_{20}\text{H}_{40}\text{O}_2$. Its silver salt contained 19.29 to 19.45 per cent of Ag; $\text{C}_{21}\text{H}_{41}\text{AgO}_2$ requires 18.85, and $\text{C}_{20}\text{H}_{39}\text{AgO}_2$ 19.32 per cent Ag.

It appeared probable, from the large amount of alcohol obtained, that they were present in the wax in the free state. 400 grammes of the wax was therefore boiled with—

ber of times with alcohol; this quantity yielded 126 grammes of soluble ingredients melting at 81° , and 274 grammes insoluble, melting at 86° . The soluble portion contained a resinous body, to which the yellow colour previously observed was due; this was removed by potash in minute quantity and plumbic acetate. A few crystallisations from alcohol and ether now yielded melissin in a state of purity.

The wax, therefore, contains no less than one-third of its mass of free wax alcohol, a fact of no little interest in vegetable physiology.

After the separation of the first crop of melissin crystals the remaining alcohols, both from the soluble and insoluble portions, were mixed and treated together. By recrystallisation, more melissin was obtained, and by repeated treatment with ether, benzol, and alcohol, several bodies were then separated; the following were analysed, and are described:—

1. An alcohol fusing at 105° , and having a composition represented by the approximate formula, $C_{29}H_{41}O_2$.

2. An alcohol fusing at 78° , and corresponding to formula $C_{24}H_{38}O_2$. It is probably cerotin.

These alcohols are all present in the wax in minute quantity as compared with that of melissin. The author did not succeed in preparing acids from any one of them.

Further attempts to identify the chief alcohol of the wax with melissin were also made. An iodide and chloride of the alcohol radical were prepared and analysed. The latter, however, did not give satisfactory analytical results, and was probably a mixture. Ammonia and aniline both act upon the alcohol, but the products obtained were not fully examined. Sulphuric acid gave an acid the potassium salt of which agrees in composition with the formula $C_{21}H_{33}KSO_4$.

A note attached to the paper mentions that the research was made in the years 1855-7, the author having since then been unable to complete it.

The PRESIDENT, in offering the thanks of the Society to the author, remarked that Sir Benjamin Brodie, who might be called the father of the study of wax, was present, and would perhaps favour the Society with some remarks.

Sir B. BRODIE, who observed that he had not come in time to hear the commencement of the paper, hoped that its publication would induce some other chemists to apply themselves to the study of wax; he said chemists, because the necessary investigations were so tedious as to require the labour of two or three persons. He himself would be very happy to render any assistance he could to anyone who was willing to take up the subject. One of the chief obstacles to be encountered arose from the extreme difficulty of deciding from the percentage composition the true atomic constitution of the compounds. He regretted that Mr. Maskelyne had not applied some of the methods which he had found useful in fixing the constitution of these compounds. The action of chlorine, for instance, gave substitution compounds analogous to chloral which were very characteristic. In the same way, it would have been almost impossible to decide by analysis whether the paraffins belonged to the ethylene or marsh gas series, but the action of chlorine upon them was perfectly definite, and tended to fix them in the latter. Another most excellent method of study consisted in forming the ethers of the wax acids, and examining them.

In the study of wax, the composition of the bees' wax produced in different countries would be found well worth investigation. He (Sir B. Brodie) had found that bees' wax from Ceylon was quite different in composition from English; it contained no cerotic acid, whereas the English wax always contained that acid in the free state. The animal wax, called cerolein, too, with its peculiar tea-like fragrance, should be examined. Its composition appeared to approximate to that of butyric aldehyde, but it was very little known. Possibly some of the candle-makers could supply the crude material. It must be extracted by alcohol, and the cold solution evaporated.

"On the Connection between the Mechanical Qualities of Malleable Iron and Steel, and the Amount of Phosphorus they Contain," by Dr. B. H. Paul. It is generally con-

sidered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal. Quite recently, an eminent metallurgist has stated as a fact that much less than '3 per cent of phosphorus produces a decided and injurious effect on steel. The author has, however, been unable to discover any evidence sufficient to justify such a conclusion, and still less any reasonable explanation of it. He has recently had an opportunity of testing the truth of this conclusion, by determining the phosphorus in some samples of the iron and steel made by the new nitrate of soda process from British pig-iron known to contain phosphorus. Seven bars of iron and two bars of steel, made by the Heaton process, were examined; their tensile strength and extension had been determined by Mr. Kirkaldy. The iron bars had a tensile strength of from 46,547 to 52,824 lbs. per square inch of area, and an extension, when subjected to this strain, of from 21 to 28.6 per cent of their length. The two cast-steel bars had tensile strengths of 80,916 and 106,602 lbs., and extended 3.3 and 13.7 per cent of their lengths. In the iron bars, the author found '144 to '38 per cent of phosphorus (average '237 per cent), and in the two steel bars '24 and '241 per cent. The author, therefore, thinks himself justified in asserting that the commonly received opinion on this subject does not always represent the truth.

Professor MILLER had had opportunities of examining some of these steels. In fact, he might say that Dr. Paul's experiments had been suggested by himself. He had found in some careful analyses of his own, very unusual quantities of phosphorus, even in samples of high class iron—iron which worked well cold, and also at a red and bright yellow heat. It could hardly be doubted that in many statements of the composition of iron the amount of phosphorus found had been too low. The old method of estimating the phosphoric acid, which involved the throwing it down as iron-salt, was unreliable. The phospho-molybdate process, employed by Eggertz, was undoubtedly the best; but even this required the greatest care to avoid getting too low a proportion of phosphoric acid. It was very difficult to ensure the entire precipitation of the phospho-molybdate. One thing was clear from these experiments, namely, that the presence of from 2 to 3 parts of phosphorus in 1,000 of iron was not so detrimental as was generally supposed.

The PRESIDENT inquired how the phosphorus existed in the iron, and the form in which it was eliminated during Heaton's process.

Professor MILLER could not speak with certainty of the condition of phosphorus in the iron; it probably existed as phosphide. It was, however, most certainly eliminated in the form of phosphate.

Dr. PRICE remarked that there was nothing new in the statement that such quantities of phosphorus might exist in wrought iron, but that with regard to steel he had yet to learn that '24 per cent of phosphorus could be present without injuring the metal. With regard to methods, he believed that the one at present in use was absolutely correct, that, namely, in which the phosphorus was separated as phosphate of iron and then determined with magnesia. The molybdate method was excessively tedious.

Mr. FORBES said that in Sweden they would not receive for making steel, iron that contained '1 per cent of phosphorus. Many works had had to stop for want of ores that were free from phosphorus. For one mine of such ore there were ten which yielded ore containing phosphorus, and they would most gladly use it if they could. He could not agree with Dr. Miller that the amount of phosphorus in iron was underestimated. The molybdate process was thoroughly understood in Sweden, and had been in use since 1856. Errors in the estimation of phosphorus could not be due to ignorance of that method.

Professor MILLER explained that he only meant to say that the molybdate process required care. No doubt the results obtained by Eggertz were perfectly correct. In answer to the President, Professor Miller then gave a short

account of the Heaton process. A quantity of the nitre was placed in a wrought-iron pot lined with fire-clay; on this was put a perforated plate of iron, and 12 cwt. of melted cast-iron from a cupola furnace were then introduced, with sand and lime. During the reaction, fumes, first white, then brown, next grey, were evolved. A violent flame and a roaring noise attended upon it. When again tranquil, the metal was emptied on the floor of the furnace; the slag ran out and the pasty mass was pressed between rollers. He was unable to tell the proportion of phosphorus in the slag. The crude cast iron employed contained 1.43 per cent, and the cast steel obtained under 3 per cent. A part, at least, of the phosphorus lost was certainly to be found in the slag.

Dr. PAUL quite agreed with Mr. Forbes that Swedish steel was free from phosphorus. As far as he could learn, there was no other evidence in proof of the injurious action of phosphorus on steel.

ACADEMY OF SCIENCES.

PARIS, NOV. 9TH, 16TH, 23D, AND 30TH, 1868.

Behaviour of Chlorides of Sodium and Potassium in presence of Metallic Vapours—Estimation of Nitrites in presence of Nitrates and Organic Matter—Cinnamate of Benzile.

On the 9th November, the following papers were brought before the Academy:—"On Isomeric Compounds of the Sulphocyanic Ethers, Homologues and Analogues of the Ethylic Essence of Mustard," by M. Hofmann; "On the Theory of Scintillation," by M. Jamin; "Effects of an Elevation of Temperature on the Calorific Phenomena Accompanying Electrolysis," by M. Raoult; "On the Pyrogenic Formation of Acetylene from the Benzilic Series," by M. Berthelot; "On the Atractylic Acid and the Atractylates, Proximate Constituents Extracted from the Root of the *Atractylis gummifera*," by M. Lefranc; "On a Method Suitable for the Formation of Emetics and Other Double Tartrates," by M. Henry; and M. Poulet addressed a note "On the Effects of the Carotid Injection of Alkaline Urates."

At the meeting on the 16th, the following memoirs were communicated:—"On the Scintillation of a Reflected Light," by M. Chevreul; "Isomeric Compounds of Sulphocyanic Ethers," "Comparison of the Metamorphoses of the Essences of Mustard and of Sulphocyanic Ethers," by M. Hofmann; "Researches concerning the Mechanics of Atoms," by M. Lucas; "Experiments on the Electric Spark," by M. Seguin; "On the Theory of Electrodynamical Actions," by M. Reynard; "Determination of the Heat from the Combustion of Oil," by MM. Scheurer-Kestner and Meunier; "On the Production of Electric Discharges in the form of a Crescent by means of Holt's Machine," by M. Gaiffe; and "On the Calorific Phenomena which accompany Electrolysis," by M. Raoult.

On the 23d November the following memoirs were submitted to Academy:—"Thermal Researches on the Galvanic Battery," by M. Favre; "On the Behaviour of the Chlorides of Potassium and Sodium in the presence of certain Metallic Vapours, particularly Sodium Vapours," by M. Le Roux; "Researches on Nitrous Acid," by M. Chabrier; "Chemical Examinations of Five Samples of Gas from the Petroleum Springs of North America," by M. Fouqué; "On Cinnamate of Benzile," by M. Grimaux; "A Reclamation of Priority concerning the Chloride of Silver Battery constructed by Drs. Warren De La Rue and Miller," by M. Pinus, completes the list.

On the 30th November, MM. Milne-Edwards, Brongniart, Becquerel, Elie de Beaumont, and Coste were formed into a commission to propose a question for the Bordin Prize in 1869. M. Becquerel presented a sixth memoir "On the Electro-Capillary Phenomena of Diffusion, the Formation of Oxides, Silicates, Crystallised Hydrated Alumina, and the Effects of Diffusion between Liquids which do not Mix." The following other communications were also made at this meeting:—"On the Temperature of Flames and its Relation

to Pressure," by M. Deville; "Study of the Obscure Calorific Spectra," by M. Desains; "On some New Carbides of Hydrogen," by M. Fritzsche; "On a Phenomenon of Fracture produced in the middle of some Blocks of Tin by the Action of Intense Cold," by the same author; "On a Modification in the Humid Method of Estimating Silver," by M. Stas; "On the Applications of Aluminium Bronze," by M. de St. Cricq Casaux; and "On the Transformation Suffered by Molecular Granulations of various origin in Solutions of Cane Sugar," by M. Le Riquet de Monchy. M. Elie de Beaumont presented a specimen of devitrified glass, and pointed out the analogies presented by this specimen with certain rocks of igneous origin. M. Palmieri continues his study of Vesuvius, and describes the eruption on the 15th November; and M. Chacornac made known the results of his researches on the physical constitution of the sun.

M. Le Roux has made some experiments with the vapour of sodium, and examined its capability or incapability of passing through rock salt. Two crucibles of rock salt were prepared, a thin plate of the same substance placed between them, and in one of the cavities sodium was placed. Notwithstanding a bright red heat maintained for several hours, the piece which was not in direct contact with the sodium vapour remained completely unaltered, even where it had been in contact with the plate already completely penetrated. Chloride of sodium is not attacked by the vapour of sodium, but soda corrodes it energetically. A very small quantity of soda suffices to hermetically seal two surfaces of rock salt, sodium preserving its lustre for several months in a crucible of this kind. Potassium vapour does not attack its chloride, but it covers the chloride with a bright blue substance in which, possibly, chemists recognise the suboxide of potassium.

M. Chabrier has studied at nitrification works, in particular circumstances, the different degrees of oxidation of the nitrogen, and especially nitrous acid. He has devoted attention to the estimation of this acid in saline mixtures, where nitrites and nitrates occur together with reducing agents. He submits to the Academy the result of the first part of his researches. The facts contained in this memoir are deduced from the following conclusions: (1) in liquids containing at the same time nitrites, nitrates, and organic matter, the nitrous acid of the nitrites may be determined by the decolourising action which hyposulphite of soda exerts on the iodide of starch, produced by the reaction of the nitrites on iodide of potassium in presence of starch and dilute sulphuric acid; (2) in the absence of nitrates and organic matter the determination could be more easily made by the decolouration of indigo solution, operating with the aid of heat, but out of contact with the air.

M. Grimaux prepares cinnamate of benzile by placing in a flask connected with a Liebig's condenser disposed inversely, alcohol, chloride of benzile, and dried cinnamate of soda. The cinnamate of soda being very slightly soluble it requires to be introduced in small portions at a time. The alcohol having distilled over water is added and the pasty deposit washed with an alkaline solution to remove cinnamic acid; ether is afterwards poured on and the deposit after this washing is dried over chloride of calcium, the ether removed by heating on the water bath, and the oily residue distilled in a vacuum. The distillate collected near 225° to 235°, cinnamate of benzile, is in the form of an oily liquid, which afterwards becomes a transparent solid. Cinnamate of benzile ($C_{12}H_{14}O_4$) occurs in small brilliant prisms, melting at 39°, and decomposing at about 350°. M. Fremy's meta-cinnamine appears to be pure cinnamate of benzile and not styrcine (cinnamate of styrone) as MM. Kopp and Kraut have thought.

PARIS, DEC. 7TH, 14TH, 21ST, 1868.

Native Arseniate of Zinc—Election of M. Jamin.

On the 7th of December the following memoirs were communicated:—"The Mechanical Equivalent"

ed by the aid of *Æther*, tending consequently to confirm the existence of this Fluid, universally diffused," by M. Burdin; "Researches on Alloys," by M. Riche; "On a Natural Arseniate of Zinc occurring at Cape Garonne," by M. Damour; "Union of Free Nitrogen with Acetylene; Direct Synthesis of Hydrocyanic Acid," by M. Berthelot. M. Jenzsch addressed a complement to his note of the 21st September, "On the Fossils from Rocks, termed Eruptive." The physical section has presented the following list of candidates for the vacant place created by M. Pouillet's decease:—(1), M. Jamin; (2), MM. Bertin, Dessains, Favre, Janssen, Le Roux, Lissajous, and Guet.

In a notice inserted in the *Comptes Rendus*, M. Friedel has made known the characters and composition of a new mineral found at Chanarcillo in Chili, to which he has given the name *adamine*. This mineral is formed essentially of oxide of zinc, arsenic acid, and water, and up to the present day is only found in very few collections; it has lately been found in France by MM. Gory and De Boutiny, in the refuse of a copper mine at Cape Garonne (Var). By a qualitative examination, M. Gory has recognised in this mineral the presence of arsenic, zinc, and cobalt. At his request, M. Damour made a more complete examination of this mineral. The *adamine* of the Cape Garonne occurs in small crystals, in a quartz rock; these crystals are usually lenticular, grouped and joined so as to offer some resemblance to a number of grains of wheat. Nearly all are tarnished, sometimes they are covered with small needles of arseniate of copper (olivinite). Their colour is generally grey, slightly rose-tinted; the hardness is a little greater than that of carbonate of lime. The density at $+15^{\circ}\text{C}$. is 4.352; M. Friedel found 4.338 for the samples obtained in Chili. The following are the chemical characters:—Heated in a tube, *adamine* evolves a small quantity of neutral water, and takes a faint bluish tint; on charcoal before the blowpipe flame, the mineral fuses into a blackish scoria, disengaging white fumes and an arsenical odour. After cooling, a white ring, tinted blue at the border, is observed to encircle the scoria. With borax or microcosmic salt, the blue colour characteristic of cobalt is obtained. Hydrochloric, nitric, and sulphuric acids dissolve the mineral completely.

On the 14th December, M. Filhol presented a memoir "On the Action of Iodine on the Metallic Sulphides." MM. Troost and Hautefeuille communicated a memoir "On some Properties of Cyanic Acid," and M. Schlosser a memoir "On the Estimation of Phosphoric Acid in Plants." At this meeting M. Jamin was elected to the vacant place in the physical section.

At the meeting on the 21st, the following memoirs were communicated:—Memoir "On the Phenomena of Static Electricity which Accompany the Rapid Destruction of the Adherence of Different Bodies," by M. Joulin; "Action of Ammonia on Phosphorus," by M. Blondlot; "On the Formation and Decomposition of Sulphides of Carbon," by M. Berthelot; "Action of Organic Acids on the Nitrites of the Fatty Acid Series," by M. Gautier; "Remarks on the Sulphide of Allyl," by M. de Clermont; "On a New Formation of Octylic Alcohol," by M. Silva; "On the Bromide of Allyl," by M. Tollens. A note by M. Ferrière, "On the Combustion of Phosphuretted Hydrogen," completes the list. Some account of these researches will appear in a future letter.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 15, 1868.

E. W. BENNEY, F.R.S., E.G.S., Vice-President, in the Chair.

"Researches on Di-methyl," Part II., by WILLIAM H. DARTLING, Dalton Scholar in the Laboratory of Owen's College. Communicated by Prof. H. E. Roscoe, Ph.D., F.R.S.

In a communication made to the Society in April last I showed that ethyl chloride was obtained by treating with

chlorine the gas di-methyl obtained by electrolysis, and that from this substance ethyl alcohol was prepared.

In continuation of that paper I beg to lay before the Society the results of the examination of the properties of the di-methyl obtained by two other processes; first by that of Schützenberger, and finally by that proposed by Frankland.

The former process consists in treating acetic anhydride with peroxide of barium, when the two gases di-methyl and carbonic acid are said to be given off; in the latter process the action of zinc on methyl iodide in sealed tubes heated to about 150°C . yields di-methyl.

These two methods were tried for the preparation of di-methyl, but were abandoned for the electrolysis method for reasons which will be noticed further on.

1. *Preparation of Di-Methyl by Schützenberger's Process.*—When peroxide of barium acts on acetic anhydride, a gas stated to be di-methyl is given off.

If the peroxide is heated with the anhydride, as Schützenberger directs, violent explosions occur. This can be avoided by mixing the peroxide with dry sand, provided the flask containing the mixture is not cooled; if it is cooled, the reaction after a time becomes so violent, probably owing to the formation of peroxide of acetyl, that explosions occur.

20 grms. of peroxide of barium mixed with 40 grms. of dry sand were poured into a flask containing 20 grms. of acetic anhydride and mixed by shaking; the gas evolved was collected in a Pèpy's gas holder, and afterwards displaced by pressure, purified by passing through a solution of caustic potash, and afterwards through concentrated sulphuric acid. The treatment with chlorine, exposure to the sun's light, and final displacement, was effected in the method described in the previous paper.

The total volume of liquid obtained from acetic anhydride prepared from one pound of phosphorus did not exceed 25 c.c., and began to boil at 40°C ., the temperature rising up to 80°C . This quantity proved too small to admit of being fractionated, in order to separate any more highly chlorinated products.

In order to ascertain the cause of so small a yield of chloride, the gas was analysed, according to Bunsen's method, and proved to be a mixture of carbonic oxide, marsh gas, di-methyl, with a small amount of olefines, the following being the result:—

Carbonic oxide.....	4.29
Olefines.....	0.63
C_2H_6	18.57
CH_4	76.51
	100.00

This analysis clearly shows that Schützenberger's description of the decomposition is incorrect, the greater part of the gas consisting of hydride of methyl or marsh gas.

2. *Preparation of Di-methyl by Frankland's Method.*—Schützenberger's method not giving the required gas, this process was tried. I took advantage of the directions given by Schöyen for the preparation of pure di-ethyl.

Into stout glass tubes closed at one end, metallic zinc, made rough on its surface, was introduced; the open end was then softened before the blowpipe, thickened, and drawn out into a strong capillary, which was bent twice at right angles, as described by Frankland. Through this the methyl iodide was introduced, and afterwards the ether, equal in volume to that of the iodide. The air was expelled by boiling the ether and closing the capillary.

Tubes thus prepared were heated to 130°C ., until all the zinc was dissolved, then opened before the blowpipe when cold, to allow any marsh gas to escape which had been formed by the presence of moisture, again closed and heated to 150°C . for several hours. The tubes when cold were then immersed in a mixture of salt and ice: the end of a narrow tube of thick caoutchouc drawn over the capillary, the other end being attached to a gas-holder containing a

saturated solution of common salt, and the end of the capillary was then broken off. The gas rushed into the holder, the internal pressure frequently projecting some of the liquid contents of the tube into the gas-holder, where in contact with the water, decomposition took place with the formation of marsh gas, it being impossible to decompose all the zinc-methyl.

The di-methyl thus obtained on treatment with chlorine, &c., yielded a small quantity of a liquid which began to boil at 11° C., and rose above 80° C. The quantity was, however, but small, in consequence, no doubt, of the presence of marsh-gas derived from the zinc-methyl, which was carried over by the pressure of the gas in the tubes; and as it became apparent that considerable difficulty would be encountered in preparing large quantities of the pure gas by this method, it was abandoned.

An analysis of this gas, according to Bunsen's method, shows that pure di-methyl is to be obtained by this method—

	Found.	Calculated for Di-methyl.
Gas employed.....	16.71.....	
Contraction.....	42.30.....	41.77
Carbonate acid.....	33.50.....	33.42

I cannot conclude this communication without expressing my thanks to Professor Roscoe and Mr. Schorlemmer for the very able assistance rendered to me throughout this research.

"On a Property of the Electric Current to Control and Render Synchronous the Rotations of the Armatures of a number of Electro-Magnetic Induction Machines;" Illustrated by Working Models; by Henry Wilde, Esq.

November 9th, 1868.

J. B. DANCER, F.R.A.S., President of the Section, in the Chair.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

MR. SIDEBOTHAM exhibited specimens of the gall fly *Cynips Lignicola* and a number of the galls formed by this species. He stated that these galls are very common, apparently much more so than a few years ago; he had tried an experiment to ascertain their commercial value, and exhibited the comparative strength of colour from them and from the blue Aleppo galls. The English galls are much lighter, and in the experiment equal weights of each were used. The result of the experiments showed that the English galls were about two-thirds the value of the foreign ones, or, according to the present market value, they would be worth about 66s. a hundredweight. In the plantations where these galls abound, he thought a man might collect easily half a hundredweight in a day, and, on the principle that nothing valuable should be wasted, he thought that it was very desirable that these galls should be collected and made use of. The galls, even when in great numbers, do not appear to injure the trees. The proper time to collect them would be the middle of September, when the flies have all eaten their way out and laid their eggs for another year's supply.

Dr. ALCOCK showed a preparation preserved by corrosive sublimate in a manner which he recommended for fine dissections. The preparation had been kept in an open cup for twelve months, simply water being added occasionally to supply what was lost by evaporation. The advantages of the plan were, very perfect preservation, no necessity for closing up so that the specimen could not be got at, no fear of losing a valuable dissection from accidental evaporation, as where spirit is used, and cheapness. The method adopted was to prepare a saturated solution of corrosive sublimate in alcohol, and when a dissection in water is in progress, a small quantity, as half a teaspoonful, of the solution is to be added from day to day if the slightest appearance of putrefaction is observed, but no more of it is used than is absolutely necessary, and by the time the dissection is completed, the specimen has become imperishable, from the union of the corrosive

sublimate with the tissues, and it may then be kept in pure water, either open or mounted in the usual way.

NEWCASTLE LITERARY AND PHILOSOPHICAL SOCIETY.

ON Thursday, December 24th, 1868, Mr. J. LOWTHIAN BELL delivered the inaugural address of the newly formed Chemical Society. We regret that pressure on our space will only allow us to give a short notice of the address, which is full of scientific interest, and will, we have no doubt, be the means of increasing the zeal of the founders and members of the society. Mr. Bell reviewed the history of the various chemical compounds now manufactured on a very large scale on the banks of the Tyne, and which furnish a field of enquiry and research rarely or never at the command of the man of science. As instances of the advantages possessed by manufacturers for promoting chemical science, the speaker quoted the discovery of selenium and thallium, found in infinitesimal quantities in the slow accumulations of sublimate in our vitriol chambers, while bromine as well as iodine were first noticed in the concentrated mother waters obtained in treating sea water and the incinerated portions of marine plants. Mr. Bell also made some excellent observations on the discoveries of Kirchhoff, Miller, Huggins, Joule, and others in connection with spectrum analysis; on the investigations of Professors Graham and H. St. Claire-Deville on the absorption and dialytic separation of gases by colloid septa; on the production of the submarine cable by insulating copper wire by means of gutta percha; and on Mr. Ansell's ingenious apparatus for indicating the presence of firedamp in mines. At the conclusion of the address the speaker dwelt at some length on the several means possessed by the members of the society for promoting chemical investigation.

The delivery of the address was frequently interrupted by applause, and Mr. Bell was rewarded with enthusiastic cheering on resuming his seat. Mr. Ladd then, by means of his beautiful apparatus and the electric light, exhibited a variety of spectra, illustrating the existence, in the stars and planets, of various metals, such as silver, copper, zinc, and the new metal thallium—which was discovered by means of the spectroscope. He also projected on the canvas a powerful electric light, and by means of a battery showed the colours of various chemical substances, and produced ozone.

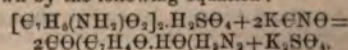
Mr. GLOVER then proposed a vote of thanks to Mr. Bell for his able and exhaustive lecture. In past times, they had a Hutton, and a Bewick; and in later times a Hugh Lee Patinson, famous for his discoveries in the chemistry of manufactures as applied to lead and the silvering process. They now had Mr. Bell, and as long as they had a gentleman among them capable of delivering an address such as they had heard that evening, they might rest assured that Newcastle would still retain her place in the world of science.

At the conclusion of the meeting a large number of the audience inspected the specimens on the table illustrative of the lecture, and the portfolio of photographs of the works of ancient masters executed by means of Mr. Swan's carbon process.

We hope to furnish our readers regularly with reports of the transactions of the new society.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

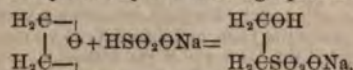
Action of Potassium Cyanate upon Amido-acids.—N. Menshutkin.—On mixing with a saturated boiling solution of sulphuric amidobenzoic acid, a saturated solution of potassium cyanate, oxybenzuraminic acid is formed, which, on cooling, separates in small crystals. The formation of this acid is shown by the following equation:—



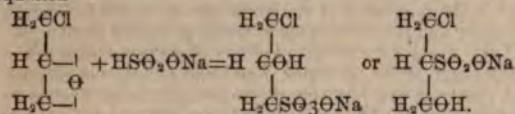
It is sparingly soluble in boiling water, better in alcohol, insoluble in ether; its salts are all soluble in water. Those which have been analysed (calcium, lead, silver) contained one atom of metal. The acid is readily nitrated by means of strong nitric acid. From amidoxybenzaminic acid, and, perhaps, also from the amide of the oxy-acid, the author hopes, by the help of his reaction, to obtain oxybiureid.—(*Zeitschr., Ch., N.F.*, iv., 275.)

Notes by E. Erlenmeyer, L. Darmstädter, and Tscheppe:—

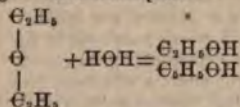
I. Synthesis of Isethionic Acid.—The sodium salt of this acid is readily formed if oxide of ethylene and sodium disulphite are heated together in a closed vessel to 100° C. The reaction is expressed by the following equation:—



II. Formation of Chlorhydroxypropylsulphonic Acid (Chlormethyl-isethionic Acid).—Epichlorhydrin at 100° C. combines with sodium disulphite with formation of the sodium salt of the above acid, according to the equation—

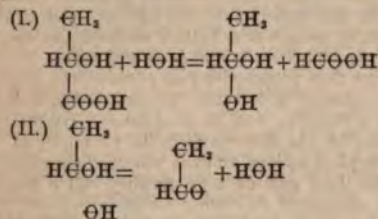


III. Formation of Alcohol from Ether.—On heating ether with water to which has been added a small quantity of sulphuric acid for some time to between 150° and 180° C., the following reaction takes place:—



IV. Decomposition of Fermentation Lactic Acid.

—This acid splits up into aldehyd and formic acid when heated for several hours with diluted sulphuric acid to 130° C. The reaction most probably passes through the following two phases:—



—(*Ibid.*, *N. F.*, iv., 341.)

Dichlorphenol.—F. Fischer.—Dichlorphenol is obtained by passing a current of dry chlorine through phenol, and purified by repeated rectifications and recrystallisations from benzol. Thus prepared it is a solid body, crystallising in long white needles, which fuse at 42° to 43° C.; its boiling point is 209°, i.e., nine degrees lower than that of monochlorphenol, which boils at 218°. Dichlorphenol forms crystalline salts of no great stability. Its ethyl ether, $\text{C}_6\text{H}_3\text{Cl}_2\Theta\text{C}_2\text{H}_5$, is obtained as a colourless oil boiling at 226° to 227°. It is readily converted into the nitro-compound $\text{C}_6\text{H}_3\text{Cl}_2(\text{N}\Theta_2)\Theta\text{H}$, which shows all the properties of that from the liquid dichlorphenol, as described by Laurent. Amidodichlorphenol may be obtained by the action of tin and chlorhydric acid upon the nitro-compound. It is described as a white crystalline body which, when moist, readily decomposes.—(*Gött. Nachr.*, 1868, 171.)

Behaviour of Metals in the Electric Current.

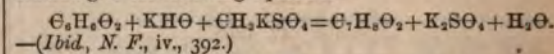
F. Wöhler.—In addition to his experiments on silver (*CHEMICAL NEWS*, No. 463, p. 189, *Am. Repr.*, Dec. 1868, page 331), the author describes the following:—Palladium as positive

electrode of two Bunsen's cells, immersed in acidulated (sulph. acid) water, becomes gradually covered with an almost black film of peroxide (PdO_2). Upon lead and thallium brown peroxide and black oxide are deposited. Osmium, in the ordinary porous condition, is freely converted into osmic acid (OsO_4). If, as electrolyte, a dilute solution of sodium hydrate is employed, the solution assumes a deep yellow colour, while, on the negative electrode metal is deposited. The same is the case with ruthenium. Osm-iridium in its natural state readily dissolves in the alkaline electrolyte.—(*Gött. Nachr.*, 1868, 169.)

Action of Iodhydric Acid upon Leucin and Tyrosin.

—On heating in a sealed vessel pure leucin with fuming iodhydric acid to 140–150° C., for about 12 hours, the former takes up one atom of water and splits up into ammonia and capronic acid. Tyrosin, which is believed to contain ethylamine, was expected, under similar treatment, to yield that base, but instead of it ammonia was liberated. The author concludes from this experiment that tyrosine is not ethylamidoparoxibenzoic acid (Barth) but amidophoretic acid, which, by the action of iodhydric acid, would break up into ammonia, phlorol, and carbonic dioxide; and, further, that the base which Schmidt and Nasse obtained by gently heating tyrosin is not ethyloxyphenylamine, but amidophlorol.—(*Zeitschr., Ch., N. F.*, iv., 391.)

Synthesis of Guaiacol.—V. Gorup-Besanez. If a mixture of equal molecules of pyrocatechin, potassium hydrate, and potassium methylsulphate is heated in a sealed vessel to 160–170° C., a light brown, half-liquid mass is obtained which has all the properties of guaiacol. It is purified by repeated washings with water. Its formation takes place according to the following equation:—



Sulphobenzyllic Acid.—O. Böhrer. Benzyl chloride, $\text{C}_6\text{H}_5\Theta\text{CH}_2\text{Cl}$, obtained by the action of chlorine upon toluol, is converted into the potassium salt of a new sulpho acid on being boiled with a solution of neutral potassium sulphite. The composition of potassium sulphobenzylate is $\text{C}_6\text{H}_5\Theta\text{CH}_2\text{SO}_3\text{K}$. The acid may be set free by decomposing its lead salt with hydric sulphide. It is very soluble in water and in alcohol. Fuming nitric acid replaces one H by $\text{N}\Theta_2$.—(*Ibid.*, *N. F.*, iv., 440.)

Ethyl Iodate.—K. Lisensko. A mixture of equal volumes of ethyl iodide and dry ether readily acts upon argentic iodate. If the temperature is not allowed to rise above + 10° C. the liquid remains colourless and the new ether undecomposed. The solution distils between 37° and 40°. The distillate at first floats upon the water with which it had been mixed, but on passing a current of air through the liquid, in order to drive off ethyl ether, it sinks to the bottom of the vessel. All attempts at further purification failed; the liquid boils at 75° under decomposition.—(*Ibid.*, *N. F.*, iv., 455.)

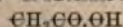
Sulpho-acids of the Hydrocarbons C_6H_{12} .—O. Jacobson has examined the sulpho-acids and their salts of the isomeric hydrocarbons C_6H_{12} , and he has found that they are sufficiently distinguished from each other to serve as means for identifying the hydrocarbons. Cumol, prepared from camphorone by the action of fusing zinc chloride, although its formula appears to be C_6H_{12} (C_6H_5) (Fittig, *Ann. Chem. Pharm.*, cxii., 309), differs from propylbenzol (derived from cumic acid). A statement, Church's, that a hydrocarbon of the formula C_6H_{12} was formed by dry distillation of barium eugenate, the author has not been able to confirm. (*Ann. Chem. Pharm.*, cxlvi., 85.)

Composition of the Crystals of Sodium Ethylate.

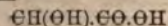
—A. Geuther and E. Scheitz.—The transparent crystals which are obtained by dissolving sodium in absolute alcohol and allowing the heated solution to cool, have the composition $\text{C}_2\text{H}_5\text{Na}\Theta \cdot 2\text{C}_2\text{H}_5\Theta$. They are soluble in ether. In a

vacuum over sulphuric acid they gradually lose the two molecules of alcohol, and are converted into sodium ethylate, $\text{C}_2\text{H}_5\text{NaO}$.—(*Jen. Zeitschr.*, F. M. and N., iv., 16.)

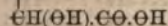
Formation and Constitution of Racemic Acid.—A. Strecker. In consequence of the relation existing between succinic and tartaric acid, the constitution of the latter (and doubtless also of paratartaric and the other modifications of tartaric acid) may be inferred from that of the former. Various formulæ for tartaric acid are possible according to whether the part C_2H_4 in succinic acid be considered as ethylene or ethylidene. If succinic acid is—



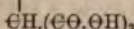
tartaric acid will be—



or it might be—



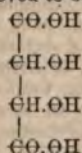
but if the constitution of succinic acid is—



then a number of formulæ for tartaric acid may be set up, in all of which, however, the two atoms of carbonyl would be attached to the same carbon atom. Assuming the first formula of tartaric acid to be the correct one, the author endeavoured to obtain that acid from glyoxal,



by the introduction into it of H.CO.OH , i.e. by treatment with hydric cyanide and chloride. On mixing an aqueous solution of glyoxal with an excess of cyanhydric acid and some chlorhydric acid, boiling for several hours, evaporating on the water bath, and adding to the residue milk of lime, a calcium salt is obtained which is partly soluble in acetic acid. The insoluble portion was converted into lead salt, and this decomposed by hydric sulphide. The acid solution thus obtained gave, on evaporation, crystals of racemic acid, $\text{C}_4\text{H}_6\text{O}_6 + \text{H}_2\text{O}$. The acid is formed according to the following equation:— $\text{C}_2\text{H}_2\text{O}_2 + 2\text{CNH} + 4\text{H}_2\text{O} = \text{C}_4\text{H}_6\text{O}_6 + 2\text{NH}_3$. By this synthesis the constitution of this modification of tartaric acid is proved to be the following:—



An analogous structure no doubt belongs to the other modifications of tartaric acid. —(*Zeitschr.*, Ch., N. F. iv., 216.)

Nitroglycerin.—F. Tilberg. Nitroglycerin (from the works at Stockholm) is decomposed when acted upon by potassium hydrate; amongst the products of decomposition are potassium nitrate, glycerin, ammonia, cyanogen, oxalic, humic, and nitrous acid. When ignited in a vacuum with copper oxide and copper, 2 vols. of carbonic anhydride, and 1 vol. of nitrogen are obtained, from which numbers the formula $\text{C}_3\text{H}_5(\text{NO}_3)_3$ is deduced. Nitroglycerin dissolves in concentrated sulphuric acid, forming with it a new compound acid which yields crystalline salts. A combustion gave 3 vol. of carbonic anhydride to 1 vol. of nitrogen. If nitroglycerin is regarded as a substituted glycerine, and the relation between it and the new acid the same as that between glycerin-sulphuric acid, and glycerin, the new compound will be dinitroglycerin-sulphuric acid. —(*Oefvers. af Akad. Forh.*, 1868, 25, No. 2, 75, and *Journ.*, p. Ch., cv., 254.)

NOTICES OF BOOKS.

Chemistry for Students. By A. W. WILLIAMSON, F.R.S., F.C.S. Clarendon Press, 1868. New Edition.

THE well-known text-book of Professor Williamson has reached its second edition in a short space of time, and this will show the general appreciation of it by students. The length of our notice of the first edition will render unnecessary many remarks on its nature, &c., that otherwise would be only just; but we may mention that its characteristics remain,—viz., a strictly chemico-philosophical way of looking at various subjects, with terseness and an almost universal omission of minute detail.

This has never been complained of, for Dr. Williamson from the first has expressed his opinion that books of detail should only be studied when important leading facts, that must always be retained for ready use, are first conquered. Miller's "Elements" and Watts's "Dictionary" are recommended as English handbooks to the student by our author.

Early students thus have this book prepared for them; it is not meant for school use; but the ideas expounded in these pages are essential to all for the due appreciation of organic chemistry, the latest of its results especially.

To the substance of the work no addition of great importance has been made; the number of sections remain as before; the book is essentially the old book corrected and slightly improved. The appearance of it is much neater, the paper now used being toned, and the sharpness and clearness of its printing would entitle it to a place on the drawing-room table rather than the coat pocket of the student. Two entirely new features are the addition of foot notes explanatory of subject matter, and squares for the amplification of the author's suggestion of the use of an absolute volume. The former mostly consist of equations showing the symbolical formulæ of the process described; in them are also given molecular and volumetric expressions in addition to those of equivalence before existing in the work. The squares aroused our curiosity; we wanted to know if Professor Williamson, like Dr. Miller (who, indeed, has always patronised volume-squares), would express the square of phosphorus as half the size of the hydrogen or oxygen square, but unfortunately, this symbolic method is not carried on in the work further than the gaseous compounds of sulphur. In addition to these improvements, tables, absolute and comparative, are given of the leading salts of the elements, and the well-known consistency of Dr. Williamson's nomenclature is even more rigidly than ever enforced in the case of organic hydrogen salts. We will not say that answers are given to the problems,—far better, the problems are fully worked out; and this addition is of special value.

A very unpretending improvement will be really found most valuable to the student. We allude to the table of contents, which has been enlarged to nearly twice its size—for of all things a deficiency in this respect for rapid reference is most annoying. This improvement, we venture to say, is second to none made upon the former edition. The old edition further contained a page of matter now, we are delighted to see, omitted—we allude to the page of corrections; the misprints also, not mentioned in that table, have been rectified, and we no longer find TO_4H , representing sulphuric acid.

The accuracy of the supervision of the text is shown in the new table of the elements, in order of their equivalency; the atomic weight of vanadium is halved and placed in the triad group, but the place claimed for it by Roscoe, in the nitrogen family, between phosphorus and arsenic, is not allowed. It will be interesting to theorists to learn that ruthenium, rhodium, and iridium are retained by our author in the group of even equivalence, and are not considered trivalent.

This group of even equivalence comprises, we are glad to see, dyads and tetrads, the hexads of Miller, Odling,

Nacquet, &c., are also retained in this group, and pentads as such, as far as elements are concerned, are not recognised; neither erbium nor terbium ranks as an element. In our opinion, this philosophic caution deserves both a wide and an early imitation.

In conclusion, we may express a hope that the new edition may run as successful a career as the old, and that the next may be still further improved, and, we hope, extended, by the introduction of the author's classification of elements by their chemical reactions.

Scientific Blue Books, No. II. Ninth Report of the Medical Officer of the Privy Council, with Appendix, London.

(Concluded from vol. xviii., p. 163, Am. Repr., Dec., 1868, page 333.)

A LARGE space has already been devoted to our abstract of Dr. Thudicum's original spectroscopic work, which we venture to say could not have been condensed further without serious loss; a summing up of the whole now remains. The reader who has followed the whole attentively will find how gradually he has been led to a brilliant result in experimental science.

Attention has already been drawn to urocyanine, and its resemblance to indigo spectroscopically; as the interest centres here we will give the special features of its spectrum. The solution taken was 1 centimetre in thickness. Its colour and spectrum remained unchanged by the addition of some sulphuric acid. The intensity was about half saturation (as expressed in a diagram). After the solution had stood at rest for twenty-four hours, some blue matter had been deposited upon the sides of the glass, and the particular spectrum was replaced by an ordinary one. It was thus shown that the urocyanine is soluble in alcohol only in the nascent state, and soon becomes insoluble. Its quantity was so small, that beyond a test with nitric acid, which showed that it was destroyed, leaving some yellow colour, no further reactions could be made with it. Several other specimens of early urine of reaction yielded similar blue and purple matters, which also admitted of the identification of their absorption phenomena with those of the case of M. Willis.

As this same urocyanine has been described by some as indigo, the following conclusions are very valuable:—In the indigo spectrum the blue is, at all events, unaltered, and a blue cast is thrown over yellow and green. The spectrum of urocyanine shows no blue at all; at the end of green the spectrum is cut off; no manipulation, such as those related, can make it appear, no concentration of the indigo solution that allows the band to appear extinguishes the blue part of its spectrum. The proof that these bodies, if both are in a pure state, are not chemically identical, however related, is complete.

The colouring matter of bile has long been known to produce with nitric acid a blue colour among others, and as the reaction of cholera urine had in the Bavarian report been likened to this reaction of bile pigment, the following comparison was made:—An ammoniacal solution of cholephæine ($C_{12}H_{11}NO_2$) was treated with concentrated nitric acid until a blue precipitate was formed. This was quickly isolated by filtration, and after washing with water, dissolved in alcohol. It yielded a spectrum resembling that of indigo and also that of urocyanine. Important differences in the spectra, however, showed that indigo-urocyanine and cholecyanine are chemically different. Cholecyanine procured by the action, first of fuming sulphuric acid, and subsequently of water upon cholephæine, showed an identity with ordinary cholecyanine. We are compelled to resist the temptation of following with our author the diagnosis of urocyanine from other important organic pigments or their products, but the omission of the note of myochrome as connected with these bodies in cholera patients would be inexcusable. It was found that the choleraic process had not changed the myochrome in its chemical composition; the identity of the spectrum of myochrome, which includes the identity of the chemical

constitution of myochrome with that of hemochrome, was anew demonstrated.

The urocyanine of cholera urine is present in such small quantities that we can never hope to obtain insight into its composition and atomic weight by direct analysis; but the information wanted has to be obtained by synthetical comparisons similar to those of our authors.

The following instructive list is given, when the ascertained spectra are arranged in the order of their succession from the red end towards the violet:—

Myohemine	.....	142° 42'	— 142° 12' = 0° 30'
Hemine	.....	142° 36'	— 142° 6' = 0° 30'
Urocyanine	.....	142° 30'	— 141° 54' = 0° 36'
Indigo	.....	142° 24'	— 141° 48' = 0° 36'
Urorubine	.....	142° 24'	— 141° 54' = 0° 30'
Hematine	.....	142° 18'	— 141° 48' = 0° 30'
Cholecyanine	.....	142° 6'	— 141° 48' = 0° 18'
Cyanine	.....	142° 12'	— 141° 20' = 0° 42'

The last-named body, a double base, obtained from animal oil, but containing iodine, possesses a spectrum which in several respects resembles the spectra below which it is ranged for the purpose of illustration and comparison. The alcoholic solution has the same purple blue colour as urocyanine, but, unlike this latter, it is easily and rapidly discoloured by acids. Like indigo it has the blue part of the spectrum bright and fully developed, and differs by this peculiarity from urocyanine and the hemochrome products.

"I have compared many more substances with those above mentioned. Organic colouring matters, particularly some from plants, yield spectra much resembling the hæmatic series, e.g., tincture of privet berry, which gives almost the hematine spectrum. Inorganic bodies, such as oxalic solution of Prussian blue, yield no separate bands, but peculiar absorptions, particularly of the red end of the spectrum. As these researches fail to throw any further light upon the particular point here inquired into, they cannot be here related."

Since this report was issued in the *Journal für Practische Chemie* of last July, Dr. Thudicum has made further remarks on the colouring matters of urine and on uromelaine, a decomposition product of urochrome. It is well known to physiologists that every colouring matter in the human economy has at least four or five different names, the x chrome of one author may equal the x xanthin of another, or the y chrome of a third with any number of permutations. If Dr. Thudicum would give to the world his coloured spectroscopic plates and his last researches, retaining his nomenclature, in one volume, the slough of despond would be crossed by a railway, by which all could travel with a chance of finding both termini, not the one of departure only.

We strongly urge, then, the want of an arrangement upon an accurate basis, including the last results of these pigments; if Dr. Thudicum does not care to face such a task, we know of no substitute for him. In default, the medical jurist and the pathologist must feel a debt of gratitude to the Government for this most valuable report afforded for their use.

The Scientific Review: a Monthly Record of the Progress of Science and its Application to the Arts and Manufactures (with which is incorporated the Journal of the Inventors' Institute). Conducted by R. MARSDEN LATHAM, Esq. Vol. iv., No. 1, January 1st, 1869.

FOR obvious reasons, one scientific journal seldom criticises a journal devoted to the same field of enquiry, nor shall we depart from this wholesome rule; but as this number has been forwarded to our office "with the editor's compliments," and as it contains some very original views and some trenchant strictures on world-renowned names, we feel constrained to allow the *Scientific Review* to vindicate its peculiar claims to a hearing, confining ourselves mainly to quotations, but taking the liberty of italicising a few noteworthy passages.

Of the Heaton process for manufacturing steel, the editor writes—

"Any tyro in Chemistry can perceive how nitrate of soda acts in refining pure iron, whatever be the quality of the product obtained."

In noticing the proceedings of the French Academy of Sciences, the editor calls M. Jamin's differential refractor for polarised light—

"An ingenious optical instrument, by means of which the torturing of a beam of light is pushed to a most exquisite degree of perfection."

The following query will doubtless receive the attention of the Academy of Sciences:—

"M. Gaube—a name which is new to us—read a paper on the composition of that beautiful little plant—the pest of our gardens—*Achillea Millefolium*; pray why does the Academy omit to print this note?"

Referring to M. Janssen's recent spectrum observations, we read—

"The day after the famous eclipse of the sun, M. Janssen imagined that by directing a spectroscope to the borders of the disc he might prove that the great protuberances were still visible (or rather their spectrum), and found that such was the case. . . . This simple observation, which might have suggested itself to a schoolboy of ten years of age, has given rise to a considerable number of short notes addressed to the Academy, and would appear, from the interest attached to it, to be one of the most marvellous discoveries of the age!"

Professor Hofmann is next favoured with the editor's disparagement.—

"Professor Hofmann continues his researches on certain compounds isomeric with sulphocyanic ethers, and illustrates them, as usual, with a host of useless formulae, which detract considerably from the interesting facts which he brings forward."

And thus is Professor Tyndall's latest discovery estimated:—

"The author encloses certain gaseous substances in a glass tube, and passes through the tube a beam of electric light. This gives rise to various optical phenomena; certain colours and forms are produced in which Professor Tyndall sees evidence of chemical decomposition. We must confess that we do not see it."

The longest article in the number, by Dr. Macvicar, is devoted to "The New Chemistry." The distinguished inventor of the tetrad will feel interested in hearing that the tetrad is the basis of the system, and that—

"The four ethereal atmospheres or dynamospheres of the four constituent units of weight of the tetrad are conceived to be unified into a sphere, so that, while the nucleus is tetrahedral, the periphery [*sic.*] is spherical, and the form, therefore, embraces within its limits all possible symmetrical polyhedra."

Our younger readers who lately witnessed Dr. Odling's brilliant experiments with the oxyhydrogen flame, will be glad to have the following lucid explanation of a phenomenon which the lecturer was necessarily obliged to describe somewhat briefly; and with the following dithyrambic strain, inspired by H and O, we cannot more fitly conclude:—

"Our hydrogen and oxygen are so dissimilar in every morphological feature, that whenever they have a chance they must unite with great force; the atom of H plunging with great velocity into the centre of O in the line of its axis, and generating intense heat or palpitation of O. Hence it is only to be expected that when both exist in the free state without any trentagonal element present to be a mould for O, and to sustain its singular form from the latter in the instant of the genesis of HO will shake itself free of its peculiarity of form, and open so as to let the axes of the five bitetrads of which it consists fall parallel to that of the incident atom of H, which also acts as a linear force, and a wedge insisting on this transformation."

CORRESPONDENCE.

Mr. Beanes's Process for treating Animal Charcoal.

To the Editor of the CHEMICAL NEWS.

SIR,—In my paper on "Sugar Manufacture," reported in the CHEMICAL NEWS of the 18th inst. (*Am. Repr. Feb. 1869, page 76*), I have made a remark regarding Mr. Beanes's process for treating animal charcoal with dry hydrochloric acid gas, which I find I am not in a position to substantiate, and which I therefore cancel. I beg also to express my regret for having published unadvisedly, and on insufficient evidence, a statement that might prove injurious to the interests of Mr. Beanes, and which that gentleman assures me is incorrect. I have elsewhere shown the superiority of the dry gas method over those formerly in use for removing calcic carbonate, &c., from charcoal; and while my opinion as regards the use of any of these processes in connection with sugar refining in this country remains unaltered, I am well aware that they are used with great advantage in continental factories where different circumstances obtain.—I am, &c.,

WM. WALLACE.

Glasgow, Dec. 28, 1868.

Chemistry in the Examinations of the Department of Science and Art.

To the Editor of the CHEMICAL NEWS.

SIR,—I am glad to find that my letter on the above subject has excited some little attention amongst your readers. One of your correspondents, "Woolwich," takes an objection to my statement, that of every ten chemical teachers not more than one has ever heard of "hydroxyl," and that of the remaining nine only one is likely to obtain any information respecting it from the ordinary manuals. Of course any estimate of this sort must necessarily be a matter of individual opinion, and I still retain mine, that taking the whole mass of teachers in this country, not one in ten ever heard of hydroxyl until they saw it in the recent syllabus of the Department; nor do I think that there is any discredit attaching to them for being unacquainted with it. The special theory of a particular teacher, almost entirely unnoticed by the ordinary works to which they are accustomed to refer for information, and from which they have in past times derived their own knowledge, it is scarcely to be expected that they should know anything at all about. Your correspondent alleges that Dr. Frankland's views have been for some time before the world, and that they are shared in by other chemists of note. The first of these facts is unquestionably true, and the second probably is also, but that does not at all disprove my position that the theory of hydroxyl is altogether too new, too questionable, and too impractical to justify its being compulsorily taught to beginners, who have more than enough to do to learn the essential and most elementary facts of the science. I most fully admit that Dr. Frankland's hypotheses on this and other subjects are very ingenious, and have much to recommend them, but I am equally certain that if teachers are to be expected to communicate them to the average students who go up for the examination of the Department of Science and Art, their chances of success are infinitesimally small. I must fully coincide with your correspondent V. T. in his remarks as to the absurdity of expecting boys—and it must be remembered that most of the students in the classes for which the examinations of the Department of Science and Art are provided are really little better than boys in knowledge, even though they may be in years—to answer questions which involve a knowledge of a terminology which, though admirable enough in its way, is not yet by any means even generally, to say nothing of universally, adopted. The fact is, that many examiners, though competent enough for their posts, as far as their personal capabilities as sci-

tific men are concerned, are quite unfitted to conduct examinations of the kind of candidates with whom they have to deal. They have been accustomed to teach young men of some education, and often of much intelligence, who are able to give up a good deal of time to the study of special subjects, and they forget that the great majority of the students in the science classes which are now being established with such difficulty in various parts of the country, have neither the time nor the capability to master more than the merest rudiments of science; and this applies also to a great extent to the science classes in middle class schools. I shall look with some interest to the results of the next examination of the Department; for if, as things at present seem to foreshadow, they should show that the standard of the examinations has been considerably raised, I believe that a blow will be struck at science teaching in this country from which it will take years to recover.—I am, &c.,

A TEACHER.

On the Fuming of Certain Acids.

To the Editor of the CHEMICAL NEWS.

SIR,—I was struck by the inquiry of a student in a late number of the CHEMICAL NEWS, why hydrochloric acid fumes when let out into the air, while ammonia, which has a much stronger attraction for water, does not?

If the student continues to read his chemistry with the same enquiring spirit that prompted this question, he will not only become a good observer himself, but he will have an influence in making our text-books better exponents of observation than some of them are, in many respects, at present.

It is not an unusual fault that our books contain too many bald facts often adopted without sufficient verification, and too little reasoning. Facts are good soldiers; theory a good general; but unless they work together, there is very little real fighting.

But to the point. Why does not ammoniacal gas fume when let out into the air?

I took the specific gravity of a solution of ammonia and found it be 0.889. Twenty-four drachms of this were put into a flask and heated over a spirit lamp. It at once entered into brisk ebullition, and there was a great head of gas bubbles from which very large bubbles expanded and burst. The thermometer rose slowly to 100° F. When the lamp was removed the boiling ceased instantly, but two or three rapid streams of small gas bubbles continued to be discharged for some time from black specks in the glass, which acted as nuclei. When the temperature was at 160° the lamp was removed, and the solution left to cool. It still smelt of ammonia; the lamp was replaced, and no gas bubbles were given off until the temperature had again risen to about 160°. The appearance of ebullition was much less marked than before, and the temperature rose to 208°, at which it became stationary (barometer, 28.69 inches). When cold, only 10 drachms remained of the 24. The specific gravity was now 0.997. The liquid had a faint smell of ammonia and a slight action on turmeric paper; but on putting the glass into another room, where the liquid could not re-absorb ammonia, it lost, in the course of some hours, all smell; it had no action on turmeric paper; it was, in fact, brought back to pure water.

If a similar experiment be made with a strong solution of hydrochloric acid, it will be found impossible to boil away all or nearly all the acid gas. If we operate on the acid solution of the specific gravity 1.21, it will part with gas until it has a density of 1.10 (at 60°), when it will have a boiling point at 233° F., and will distil unchanged.

We see, then, that although ammoniacal gas and hydrochloric acid gas are greedily absorbed by water, there must be some important differences in the constitution of the respective solutions. We have seen that the alkaline solution is much lighter than its own bulk of water, the acid solution much heavier; that the presence of ammoniacal

gas in water lowers its boiling point, while the presence of hydrochloric acid in water has a contrary effect. Hence the mode of combination between ammonia and water must be different from that between hydrochloric acid and water. The one must be a case of simple adhesion, the other of true chemical combination as well as adhesion.

Ammonia let out into moist air, simply adheres to the moisture and increases its volume. Vapour of alcohol, ether, &c., does the same. Now any amount of aqueous vapour that the air can maintain in an invisible elastic state, at a given temperature, it can maintain with increased effect in the case of ammonia vapour, alcohol vapour, &c. Hence the combination with these vapours with the moisture of the air is necessarily an invisible compound.

Hydrochloric acid gas, on the other hand, let out into the air, combines chemically with the moisture, producing condensation or diminution of bulk. Hence the compound is visible just as the condensation of pure steam in air produces visible vapour.

Fuming nitric acid and Nordhausen sulphuric acid are also cases in point. Concentrated nitric acid exposed to the air absorbs moisture until it attains the density of 1.424, when it distils unaltered at a boiling point of 250°.—I am, &c.,

C. TOMLINSON.

Highgate, N., Dec. 28, 1868.

Ozone.

To the Editor of the CHEMICAL NEWS.

SIR,—The development of atmospheric ozone during the past month has been very abundant. I enclose the particulars of it as indicated by the test papers, scale 0 to 10:

DECEMBER, 1868.

1st.—8.7	9th.—9.2	17th.—7.5	25th.—8.0
2nd.—1.0	10th.—7.5	18th.—7.5	26th.—8.7
3rd.—8.5	11th.—8.5	19th.—8.7	27th.—9.0
4th.—8.0	12th.—9.2	20th.—7.2	28th.—8.5
5th.—9.0	13th.—8.7	21st.—8.7	29th.—8.5
6th.—9.0	14th.—8.7	22nd.—9.2	30th.—6.5
7th.—9.0	15th.—8.7	23rd.—8.7	31st.—8.7
8th.—9.0	16th.—8.2	24th.—8.7	

The test papers used were Schönbein's, as sold by Casella; they were hung on the inside of the roof of my thermometer stand, and were changed every day at 9 a. m.

Some experiments made in 1867 led me to hope—as I mentioned in a short communication to you (CHEMICAL NEWS, No. 425, p. 48 [*Am. Repr. March, 1868, page 149*]) that moistened silver leaf might be used as a test for detecting atmospheric ozone; but further experiments made in the beginning of last year on Beachy Head gave no reliable result.—I am, &c.,

R. C. C. LIPPINCOTT, jun., F.M.S.

Over Court, near Bristol,
Jan. 5, 1869.

The Cohesion Figures of Liquids.

To the Editor of the CHEMICAL NEWS.

SIR,—I had the pleasure, last night, at the *soirée* given at King's College, of seeing Professor Woodward work the apparatus (contrived by him and described at p. 21 [*Am. Repr. March, 1869, page 117*] of your journal) for showing the cohesion figures of liquids on a large scale to an assembly of persons.

The apparatus answered its purpose admirably. It is simple in arrangement and easy to manage. The water surface, 3 inches in diameter, on which the drops are deposited and the figures formed, is quite accessible, and nearly as easy to work with as the water in my shallow glasses 4 inches in diameter. The heat of the lamp has an effect on the water, and allows the development of figures on the smaller scale which would probably not take

place at ordinary temperatures. The screen, 5 feet in diameter, is well filled and the definition good. Some of the figures are a little too faint, owing to the great expansion and the brightness of the light, and for similar reasons colour, which is so charming a feature in many of the figures, is wanting.

The figures shown on this occasion were those of only a few liquids, viz., creosote, a mixture of equal parts carbolic and cresylic acids, benzol, oil of lavender, and a solution of camphor in benzol. I am satisfied from what I saw that the figures of a large number of liquids might be exhibited with ease and in rapid succession, provided the lecturer was assisted by persons who understood the conditions of the illustrations. I may, perhaps, be pardoned if I state briefly what these are, as success or failure will very much depend on the mode in which these conditions are observed.

The most essential condition in the production of these figures is chemical cleanliness. To insure this, one water recipient (No. 1) (marked B in the figure, page 21, *ante*) ought to be in process of cleaning; a second (No. 2) ought to be clean, and filled with water, while the third (No. 3) is on the point of being removed from the apparatus. Thus there ought to be three water recipients in use.

Next, as to the mode of cleaning. As soon as No. 3 is removed from the apparatus its contents are to be emptied into a waste pan, and clean water poured over it from a jug into the pan. It should then be filled with a moderately strong solution of caustic potash, which is not to be thrown away, but poured into a reserve potash jar. (A quart Phillips's jar with a funnel in the mouth is a convenient receptacle for the potash solution.) When the water recipient, No. 3, has thus been washed with potash, it should be again rinsed with water, and, lastly, filled with clean or distilled water from a bottle—not from a washing bottle by means of a blowing tube, but simply from a clean bottle, which is to be kept closed when not in use. In filling No. 3, it may be placed on a clean cloth or flat surface of sponge, so as to dry the flat bottom surface. By this time No. 2 is resting on such a surface ready to be transferred to the apparatus, and No. 1 is in process of cleaning. In this way there need be no delay in producing the figures, and the lecturer will be able to resist the temptation, should a drop fail to spread, of waiting in hopes it will do so, or of trying another liquid on an already impure surface.

Next, as to the method of delivering the drops to the surface of the water. It is commonly supposed that provided the drops reach the surface it does not much matter how. They are generally allowed to fall upon the water. This is quite wrong, and may be a source of frequent failure. A distinct drop should be gently delivered to the centre of the water from the end of a glass rod, with a steady hand and the absence of every kind of disturbance. In this way we get symmetrical figures of great beauty. The glass rods, when not in use, should be kept in a solution of caustic potash. When one is taken out it should be passed through clean water with a brisk stir and then wiped in a clean cloth. It may now be dipped into the oil, &c., and the liquid left to drain, until it is seen that a distinct drop can be fairly delivered. The rod is now to be wiped in a dirty duster (No. 3), then in a moderately clean duster (No. 2), and, lastly, in a clean duster (No. 1) before returning it to the potash solution.

Pipettes and dropping tubes should only be used for ether, alcohol, and those liquids of which the figures have a short duration. A drop being delivered to the water surface, the hand should be removed for a moment, to allow an uninterrupted view on the screen, but the moment one figure has vanished another drop should be deposited on the surface. In this way a perfect idea of the figure will be gained from a succession of optical images.

By a judicious use of the caustic potash solution the apparatus can be kept in good working order; but after

using oils for some time the water vessels, glass rods, &c., require to be washed in strong sulphuric acid and well rinsed. The lecturer will soon find out for himself when this is necessary.

Another source of failure in the production of these figures lies in the impurity of the figure-producing liquid. One of the most difficult figures to produce is that of oil of lavender (it was admirably shown by Professor Woodward's apparatus): one reason is that this oil is so commonly adulterated with oil of turpentine; another that the oil becomes partially resinified by age. The figure, produced last night, was from a Mitcham oil about eight years old, redistilled by me nearly three years ago. I have several specimens of these oils of different ages; they all give good figures, but some foreign oils that I have by me produce nothing but disappointment.

Solid carbolic acid in small fragments rotates on the water surface with immense velocity, after the manner of camphor. (Camphor also may be tried, but the fragments should be scraped from a freshly cut surface with the point of a pen-knife.) If a needle of the commercial acid be placed on the water, it darts about, suddenly liquifies, forms into a disc from which angry-looking waving forked tongues proceed, and so it wastes away. If the liquid acid be used, care must be taken to deliver it gently to the surface, or it will slip through and form an inert globule at the bottom of the water.

Carbolic acid, or a mixture of this and cresylic acid, forms an active vigorous figure, and if a drop be placed on the same surface with what is left of the lavender figure, the mutual attractions and repulsions form a surprising sight.

Cresylic acid leaves delicate silvery flakes on the surface of the water, and in this way the presence of a few drops per cent of this acid in carbolic acid can be detected.

I intended to have given a list of liquids likely to form good figures before an audience, but as this letter is perhaps already too long, I must defer doing so.—I am, &c.,

C. TOMLINSON.

Highgate, N., Jan. 15, 1869.

On the Artificial Formation of "Atacamite."

To the Editor of the CHEMICAL NEWS.

SIR,—In the *Journal of the Chemical Society* for this month, p. 24, Mr. Church, in continuing his mineralogical notices, states that in 1864 he commenced a series of experiments upon the action of salt on "chessylite," whereby he hoped to elucidate the formation of atacamite when sea water acts on copper ores. The author continues:—"The only really successful experiment was one in which the following substances had been placed together:—200 c.c. of a 10 per cent solution of salt gave 2 grammes chessylite."

The word *gave* is doubtless the printer's error. The sentence should read, I imagine, "200 c.c. upon 2 grammes chessylite."

Mr. Church further says:—"The blue colour of the finely powdered chessylite slowly disappeared, a pale green tint taking its place, while at the same time the saline solution became notably alkaline from the conversion of the sodium chloride into carbonate. In the following table the composition of chessylite, of its chlorinated product, and of atacamite are compared together:

Chessylite.	Chlorinated Product.	Atacamite.
CuO 69.2	59.55	53.6
CO ₂ 25.6	—	—
H ₂ O 5.2	18.14	16.2
Cu —	10.47	14.3
Cl —	11.70	16.0

This experiment recalls some researches of my own made as far back as September, 1858, and published in the *Chemical Gazette*, vol. xvi, p. 430, wherein it is stated—

that the oxide of copper mechanically brought over by the draft from the calcining furnaces into a culvert running along the shore of the Pacific Ocean, the floor of which was composed of sandy rock through which the sea water permeated, became, after some months, entirely converted into the sulphates and oxychlorides of the metal. After separation of the former, the oxychloride was found to have the following composition:—

Cu.....	56.92
Cl.....	16.30
HO.....	16.14

or—

CuO.....	53.11
CuCl.....	30.73
HO.....	16.14

leading to the formula, $3\text{CuO}, \text{CuCl} + 4\text{HO}$. Native atacamite gives—

Cu.....	57.13
Cl.....	16.07
HO.....	16.07

More than 8 tons of atacamite were thus obtained.—I am, &c.,

FREDERICK FIELD, F.R.S.

Household Poisoning: The Tinning of Saucepans.

To the Editor of the CHEMICAL NEWS.

SIR,—In connection with the extract inserted in the CHEMICAL NEWS of the 11th ult. (*Am. Repr.*, Feb. 1869, page 98), on "The Tinning of Saucepans," I hope you will consider the following worthy of space in your valuable columns:—

For some few months my wife, children, and self suffered exceedingly from pains in the stomach and bowels, accompanied by diarrhoea. A sustained contest was kept up between medicine and illness, in which the latter was certainly becoming victorious. Ultimately, on account of defeat, my wife's medical attendant stated that her symptoms were peculiar and unaccountable. This assertion excited my suspicion that her sufferings resulted from poisoning. Being most fortunately a chemist, I at once secured what were at hand to test for poisons; they were—1 pint of toast water, about 1 pint of tea (the remains of my own breakfast), and a pint of drinking water. The three fluids I mixed, strained, tested carefully, and analysed; and, I may add, was horrified, as well as gratified, to find an enormous quantity, comparatively speaking, of both copper and lead. Eliminative remedies were promptly administered. For two days my wife continued to progress slowly; the morning of the third day from the detection of the causes of her illness she strongly perceived a disgusting metallic or coppery taste, her gums were discoloured and painful, and she sank into a state of collapse, in which apparently hopeless condition she remained for three and a half hours. To the credit, however, of medical skill as a means, she was rallied, has continued to progress, and is now almost wholly recovered. Previous to sinking into this state, she had vomited nearly half a wineglassful of a beautiful bright saffron-coloured fluid, which I kept, and in which I found a notable quantity of copper and lead, as well as a remarkable proportion of iron and magnesium phosphate; the iron was derived from the mains through which the water is supplied and the cooking utensils, and the magnesium phosphate from toast water.

Now with regard to the tinning of saucepans; these, I regret to say, are not the only tinned cooking utensils. Here in the north of England, and, I believe, throughout the United Kingdom, there is nothing more common in an ironmonger's shop than pots, pans, kettles, &c., lined with this beautiful but dangerous metal. I know doctors do not generally condemn it as such; I must, however, respectfully differ from them. I presume their reason for permitting its use is the fact of air and water but slowly acting

upon it at ordinary temperatures; boiling, stewing, and roasting, however, are not ordinary temperatures—nor are the fluids heated therein, as a rule, free from acids. Moreover, through negligence or ignorance, cooks partially fill vessels lined with this substance, and place them on fires which speedily evaporate or boil down the contents. The flames now wrap the vessels, elevating the temperature of the exposed tin, whereby it is rapidly oxidised. If not oxidised thus quickly it is soon dissolved by the liquors with which it is heated. When tin is received into the stomach it at once comes into contact with the gastric juice, which contains free hydrochloric acid, with which it combines, forming a most irritant poison.

Another most serious objection to the use of tinned vessels is the admixture of lead mentioned in the extract above referred to. About two months since, when investigating the cause of my family's sufferings, I found in my house a small tinned pan; the tinning of this vessel yielded on analysis over 18 per cent. of lead. Nearly the whole of the tin had disappeared from the sides; two small lumps of alloy of it and lead remained at the bottom. I have since examined several tin pots, &c., which had been in use for twelve months, and found them in an almost identical condition; they caused a great deal of illness and had to be rejected. The fact of tin being almost completely removed from the sides is a practical proof, if such be necessary, of the oxidation and solution before mentioned. Now I submit that copper, brass, and tinned vessels for the preparation of food can and ought to be discarded. Those made of iron, or iron porcelain-lined, would be uninjurious and excellent substitutes. There are at present many victims to disease the cause of which they are completely ignorant of, but which could be truthfully charged to brass, copper, and tin. Doctors are defeated and discouraged, and numbers die annually whose lives might be saved by the disuse of poisonous metals for domestic purposes. If chemists of repute or status would bring this serious subject somewhat prominently before medical gentlemen, the latter would not be slow to adopt valuable suggestions, and their instructions to patients, without the aid of law (as in France and Prussia), would compel manufacturers to desist from producing articles for which there would be no demand. I trust the gravity of the subject will be a sufficient plea for asking you to insert this rather lengthy letter.—I am, &c.,

J. C. LEE.

Artificial Formation of Atacamite.

To the Editor of the CHEMICAL NEWS.

SIR,—Permit me to refer, in a few words, to Mr. Field's interesting communication to the CHEMICAL NEWS on the subject of atacamite (*Am. Repr.*, March, 1869, page 155).

I was aware that atacamite had been formed artificially in several ways. But my experiments were made with the intention of trying the action of chloride of sodium upon all the common ores of copper occurring in Cornwall. And I wished to do this under perfectly definite conditions. The paper in the *Journal of the Chemical Society* gives the only one of my results which approached success. Other experiments, with malachite, redruthite, chalcophyllite, &c., have not yet been completed.

It will be recollected by the readers of my papers on cupric oxychlorides in the *Journal of the Chemical Society* (1864) that I therein showed that the Cornish atacamite, first described as an English species by me, had the same composition as the Chilean specimens analysed and described by Mr. Field.

I need scarcely add that the correction suggested by Mr. Field in the wording of a sentence in my paper gives the meaning intended to be conveyed by the paragraph in question.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester,
Jan. 27, 1869.

The Cohesion Figures of Liquids: Oleographs.

To the Editor of the CHEMICAL NEWS.

SIR—I have received a number of applications for an opinion on Dr. Moffat's oleographs of the cohesion figures of liquids. Several persons who deal in, or use oils largely, are anxious to make use of the process, provided its results be reliable. Perhaps you will allow me to give my reply through the medium of your journal.

Dr. Moffat has been so good as to send me thirty-six impressions illustrative of his ingenious process. I am sorry not to be able to report favourably on them as types of cohesion figures. Their chief fault is the absence of distinctive character. These thirty-six oleographs are so much alike, that they might fairly pass for variations of one oil. They consist, more or less, of a large disc perforated with holes. This arises from allowing the oil to remain too long before an impression is taken. There is a moment in the existence of every film, when the characteristic figure is presented, by which it can be recognised and the purity tested. If this characteristic figure could be seized and fixed at the right moment, the process would be of value, for we should then not only have figures of great variety and beauty (those of no two liquids being alike), but such figures would serve as types for comparison: whether the oleographic process is capable of grasping this result, I cannot say; but I think an attempt ought to be made with that end in view. I have published a considerable number of figures in which the characteristics are presented. Some liquids, such as the oils of lavender, turpentine, coriander, &c., may have each two or more characteristic phases; these should, if possible, be given.

In the *Philosophical Magazine* for June, 1867 (Plate IV.), are represented the three characteristic phases of oil of coriander. Now no oleograph of this oil would satisfy me that did not represent these three figures. The third figure of this group would print as a perforated disc, as in Dr. Moffat's oleographs, but this itself would be of no value at all, for it would distinguish nothing unless associated with the other two phases which distinguish oil of coriander from all other liquids. Oils of the same family present figures with broad features in common, but with essentially different details. No one, for example, would hesitate to distinguish between castor and croton oils; but if the figures were left one, two, or three minutes on the water or other surface, all character would be lost. Before any one attempts to fix these figures, he should educate his eye (and this may soon be done) by a careful study as to what one liquid does that is different from any other liquid, how long it takes in doing it, and whether the peculiarity in question can be fixed at the right moment.

Supposing the oleographic process to be made capable of fixing the characteristic forms of these figures, it can, I suppose, never be made to fix the colours which often greatly heighten their beauty.—I am, &c.,

C. TOMLINSON.

Highgate N., Jan. 19, 1869.

MISCELLANEOUS.

The Royal Mining Academy in Berlin.—As this Mining Academy is a scientific institution of the first rank in Germany, the following notice concerning it may be interesting to the English scientific public:—The lectures of the Mining Academy are arranged in such a manner that a student may finish the complete course in two years; the students also enjoy the privilege of inspecting the different Prussian mining and metallurgical establishments during the vacations, and besides several times yearly they have the opportunity of excursions to those establishments in company of the professors. The lectures of the present half year, commencing on the 2nd of November last and

ending on the 19th of March, 1869, treat of the following subjects:—

1. Mining Technology—five lectures weekly by Bergrath Hauchecorne; 15s. half-yearly.
2. Technology of Saltworks—one lecture weekly by Bergrath Hauchecorne; 3s. half-yearly.
3. General Metallurgy—four lectures weekly by Professor Kerl; 12s. half-yearly.
4. Metallurgy of Iron—four lectures weekly by Bergrath Wedding; 12s. half-yearly.
5. Founding and Moulding—three lectures weekly by Dr. Dürre; 12s. half-yearly.
6. Chemical Technology—two lectures weekly by Professor Kerl; 6s. half-yearly.
7. General Assaying—six lectures weekly by Professor Kerl; £1 7s. half-yearly.
8. Blowpipe Assaying—two lectures weekly by Professor Kerl; 9s. half-yearly.
9. Assaying of Iron—three lectures weekly by Bergrath Wedding; 13s. 6d. half-yearly.
10. Petrography—four lectures weekly by Dr. Laspeyres; 12s. half-yearly.
11. Geology, with special attention to the Stratified Formations—four lectures weekly by Professor Beyrich; 12s. half-yearly.
12. The Geological Formation of the Globe—one lecture weekly by Dr. Lossen; gratis.
13. On Volcanoes—one lecture weekly by Professor Roth; gratis.
14. Mineralogical Repetitions—four lectures weekly by Professor G. Rose; gratis.
15. Mineralogical Exercises—four lectures weekly by Dr. Eck; 12s. half-yearly.
16. Chemistry of Minerals—three lectures weekly by Professor Rammelsberg; gratis.
17. Repetitions of Analysis of Minerals—four lectures weekly by Dr. Finkener; gratis.
18. Practical Instruction in the Analysis of Minerals—(a), quantitative; five hours daily by Dr. Finkener; £3 half-yearly. (b), qualitative; four hours weekly by Dr. Finkener; £1 4s. half-yearly.
19. Analytical Geometry—five lectures weekly by Professor Bertram; 15s. half-yearly.
20. Mechanical Science—six lectures weekly by M. Hörmann; 18s. half-yearly.
21. Applied Mechanics—six lectures weekly by M. Hörmann; 18s. half-yearly.
22. Surveying of Mines—four lectures weekly by Berg-Assessor Kauth; 12s. half-yearly.
23. Instruction in Drawing—eight lessons weekly by Berg-Assessor Kauth; gratis.
24. Laws of Mines—two lectures weekly by Geh. Ober-Bergrath Ackenbach; gratis.

"The World of Wonders."—The first part of a new publication, issued by Messrs. Cassell and Co., the well-known popular publishers, entitled "The World of Wonders," certainly more nearly approaches the writings of the celebrated Baron Munchausen than any modern publication we are acquainted with. At the very time the bulk of the press is endeavouring to dissipate vulgar errors and sow the seeds of true physiological knowledge—the importance of which, in a medical point of view, cannot be too fully insisted on—we have in this cheap serial a collection of all the absurdities and historical monstrosities of the middle ages, for the enlightenment of the public mind. On one page is a picture of a mermaid and a merman; and though the opening paragraphs of the description mildly insinuate a doubt of the existence of such beings, the authentic (?) details, dating from 1187, 1430, and 1610, which are given at length, will go far to convince the non-sceptical mind of their truth. Again, on the very next page we find an article on "Wonderful Births," in which we have a *richauffe* of all the old women's tales of multiparous women, winding up with the legend of Mrs. Bonham who 1

seven children at one birth, all living, and all christened at the same font! The "Wonders of Digestion" form the subject of another article, in which we are informed that the stomach is "a large bag, the whole of whose surface is covered with a series of tiny finger-like projections, from every part of which a thin fluid is pouring out"! The following we do not pretend to understand, and we should like to know what idea it will convey to the simple reader:—"As the chyle is absorbed it changes its character. First, the presence of fibrin begins to manifest itself; then it gradually becomes coloured, white corpuscles, apparently identical with those of blood, being formed in large numbers." The article in question concludes with an account of a juggler who passed a sword "too far down the windpipe" into his stomach, where it was nearly all dissolved, only "a foolish medical man ordered the conjurer horse exercise," which led to "a severe internal wound and death." "The Living Skeleton," "Wonderful Frosts," "A Wonder of Intrigue," "Wonderful Women," "Giants," all more or less flavoured with the apocryphal, are duly recorded; but perhaps the most "Wonderful" paper is one on "Wonders of Vegetation," with three illustrations of a turnip with a human face (grown in 1682), a radish in the form of a human hand (A.D. 1672), and a parsnip held by a lady's hand (of unknown antiquity). We wonder who the compiler of such a farrago of absurdities can be, and imagine that he must belong to the order of funny if not wonderful dogs which are not mentioned in the work—unless, indeed, we are suffering from the "optical delusion" recorded in large type in the same pages—*Lancet*.

The Photographs of the late Eclipse taken in India.—S. Anderson, Lieut. Royal Engineers, Assistant Instructor in Photography at the Royal Engineer Establishment, Chatham, writes to the editor of the *Photographic News* as follows:—

"With reference to an article that appeared in your impression of 23rd ultimo, entitled 'Failure of Photographing the Eclipse in India,' in which you have unjustly expressed an opinion that the photographers of the Royal Engineers detailed for that expedition were not 'experienced' in the art of photography, I beg to inform you that Sergeant Phillips, R.E., the senior photographer, has been employed in Palestine on two expeditions under the auspices of the Palestine Exploration Committee, and that his name is well known in connection with the photographs published by that Society. He had, therefore, great experience of photographing in a hot climate, but, in common with other photographers, he had not had much experience in photographing eclipses, especially in cloudy weather. I may add that Major Tennant has expressed an opinion that his six negatives are equal in scientific interest to any that have been obtained in Spain, and he has valued them at £150 each. The following extract from the *India Gazette* speaks for itself:—'The services of Sergeant Phillips, and Sappers Talbot and Conway, of the Royal Engineers, have been great. They have had a good deal of hard and harassing work in making everything ready. Sergeant Phillips, in particular, has been most useful, and I have much of the success of all preparations to thank him for. The partial failure of the plate observations has been from causes beyond these men's control, and I would respectfully solicit that His Excellency in Council would be pleased to grant a month's donation of pay to each.—(Signed) J. F. Tennant, Major R.E. As recommended by you, His Excellency in Council sanctions the grant of a donation of one month's pay to Sergeant Phillips, and Sappers Talbot and Conway of the Royal Engineers.' In conclusion, I may be permitted to add that even if this 'comparative failure' had been the fault of the men, this would not have been logical ground for hinting that the Royal Engineer photographers are 'not familiar with photographic operations.' Lord Napier, in his despatches, repeatedly mentioned the 'success obtained and good service rendered by the Royal Engineer photographers under most trying circumstances in Abyssinia. In that expedition photography was the field

printing press. Staff officers' reconnaissance sketches brought in during an afternoon were at once photographed, and reduced to a uniform scale during the operation, in order that different sketches, if they overlapped, might be subsequently joined together. The sensitised paper was prepared during the night, and impressions struck off in the morning. The prints were finally mounted on linen, and distributed throughout the force. This was the principal work of the photographers, who had also to take care of the mules, carry their arms, and march as other soldiers. In addition to the large collection of negatives of plans, they have brought home a most valuable collection of about eighty negatives of general views, prints from which will be exhibited before the Photographic Society this month. Sergeant Harrold, R.E., the senior photographer, shortly before taking the interesting views of Magdala, was detailed as one of the storming party, and for his conspicuous gallantry at the assault of Magdala has obtained a medal for distinguished conduct in the field."

The following remarks are appended by the editor of the *Photographic News*:—

"We are glad to learn that the photographic operations in connection with the recent eclipse observations in India were more successful than the first report indicated. Our correspondent must remember, however, that our remarks were based upon the statements of Major Tennant himself, who described the whole of the plates as 'covered with spots,' and as 'showing but faint traces of the corona;' and he attributed this to the 'concentration of the nitrate of silver solution' by heat. Now this is a condition of things in no wise attributable to the eclipse. It could only have arisen from want of care or want of knowledge, and it is fair to assume that it was to lack of experience, and not any more culpable cause, that such a result was due. If we do the Engineers in whose care the photographic operations were placed any injustice, we regret it, and can only point to Major Tennant's report, and the contrast furnished by the results of the German expedition, in justification of our remarks. Our correspondent mistakes us in fancying that we imply that skilled photographers are not to be found amongst the Engineers. We have before spoken highly of the skill and success of Sergeant Harrold in Abyssinia, and we have had reason to believe that it was owing to the absence of the most accomplished Engineer photographers in Abyssinia that less able men were at the service of Major Tennant's expedition. In our allusion to the Engineers we merely put a hypothetical case, saying if the men told off were not familiar with photography, &c., &c. It is much more pleasant to us to believe that this expedition was in some degree successful than that it was a complete failure."

Action of Water on Lead.—Professor Parkes, F.R.S., of Netley, calls attention to the fact that it has always been seen that the action or non-action of water on lead could not be entirely accounted for by the usual statements on the subject, and lately Dr. Frankland has made a curious observation, which may throw light on the subject. He found that water which acted on lead lost this power after passing through a filter of animal charcoal. He discovered this to be owing to a minute quantity of phosphate of lime passing into the water from the charcoal; on comparing two natural waters, that of the river Kent, which acts violently on lead, and that of the river Vyrnwy, which, though very soft, has no action on lead, he found that the latter water contained an appreciable amount of phosphate of lime, while none could be detected in the Kent water. This observation may probably explain much of the discrepancy of evidence in respect of the action of soft water on lead.—*Journal of the Society of Arts*.

How Popular Science is Written.—In a letter on "Poisonous Dyes," recently sent to the *Times*, commenting on the highly explosive nature of the dye which was supposed to be used, Mr. Crookes wrote—"It is almost as explosive as nitroglycerine, and has already

destroyed one factory, with loss of several lives. Should the dye retain this character in the fabric, the wearers of these socks would be able to vary the excitement they are now indulging in in a highly sensational manner." This harmless little jodeling, perpetrated two months ago, has this week been disinterred by the editor of a contemporary which occasionally dabbles in popular science, and now appears in the following shape;—"Mr. Crookes has recently asserted that woollen stockings dyed with picrate of potash are liable to explode on the feet of those who sit too near the fire."

The Royal Polytechnic.—The Christmas entertainments of this institution include a lecture on "Singing and Sensitive Flames" by Professor Pepper, and "The Mysterious Hand," which prove the spirit-wonder called the "Planchette" to be a piece of jugglery. The hand is placed on a sheet of transparent plate-glass, and it distinctly writes answers to any questions proposed, the answers being communicated to the querist on a card, thus furnishing him with a specimen of the mysterious handwriting. There is also a musical entertainment by Mr. George Buckland, called "An Eastern Story;" an instructive lecture by Mr. J. L. King, on the "Phenomena of Nature;" and a magical illustration of the Old German Story, "The Spectre Barber," by Mr. and Mrs. Coote. Professor Pepper continues his admirable lecture on "A Machine-made Watch," and other amusing entertainments are provided for Christmas visitors.

Detecting the Adulteration of Olive and Sweet Almond Oils.—Lipowitz has recommended the use of hypochlorite of lime, bleaching powder, as a means of detecting the adulteration of olive and also of sweet almond oil with the oil of poppy seed (Möhnöl). When eight parts of either olive oil or oil of sweet almonds is rubbed up and shaken with one part of bleaching powder and left at rest, it will be seen that even after some four or five hours a layer of clean and limpid oil separates and floats at the top and surface of the mixture, which layer is, if the oils operated upon are pure, at least half the bulk of the original mixture; if, however, poppy-seed oil is mixed with either of the two oils just mentioned, and the same experiment then repeated, the mixture gets the appearance of a liniment from which no oil separates. Sweet oil of almonds, adulterated with one-eighth part of poppy-seed oil, behaves as if it were almost pure poppy-seed oil. Büchner and Brand have found Lipowitz's statements correct as regards sweet oil of almonds, but not as regards oil of olives; but they add that the olive oil they operated on was already old. The action of Lipowitz's reagent is explained by the fact of the rapid oxidation of all so-called drying oils which, on drying, yield solid products before entirely changing, by continuously absorbing oxygen into water and carbonic acid. Linseed oil, hemp-seed oil, poppy-seed oil, oil from walnuts, croton oil, castor oil, are all drying oils. The frying of drying oils is, in fact, a process of slow oxidation of these oils.—*N. Br. Arch.*

Silvering Glass Specula.—Several correspondents having made enquiries respecting Mr. Browning's silvering process, we are induced to reprint the following:—

To Silver Glass Specula.—Prepare three standard solutions. Solution A—Crystals of nitrate of silver, 90 grains; distilled water, 4 ounces; dissolve. Solution B—Potassa, pure by alcohol, 1 ounce; distilled water, 25 ounces; dissolve. Solution C—Milk-sugar, (in powder) $\frac{1}{4}$ ounce; distilled water, 5 ounces. Solutions A and B will keep in stoppered bottles for any length of time; solution C must be fresh.

The Silvering Fluid.—To prepare sufficient for silvering an 8-inch speculum:—Pour 2 ounces of solution A into a glass vessel capable of holding 35 ounces. Add, drop by drop, stirring all the time (with a glass rod) as much liquid ammonia as is just necessary to obtain a clear solution of the grey precipitate first thrown down. Add 4 ounces of solution B. The brown-black precipitate formed must be just redissolved by the addition of more ammonia, as before.

Add distilled water, until the bulk reaches 15 ounces, and add, drop by drop, some of solution A, until a grey precipitate, which does not redissolve after stirring for three minutes, is obtained; then add 15 ounces more of distilled water. Set this solution aside to settle. Do not filter. When all is ready for immersing the mirror, add to the silvering solution 2 ounces of solution C and stir gently and thoroughly. Solution C may be filtered.

To prepare the Speculum.—Procure a circular block of wood 2 inches thick, and 2 inches less in diameter than the speculum. Into this should be screwed three eye-pins, at equal distances. To these pins fasten stout whipcord, making a secure loop at the top. Melt some pitch in any convenient vessel, and having placed the wooden block face upwards on a level table, pour on it the fluid pitch, and on the pitch place the back of the speculum, having previously moistened it with a thin film of spirit of turpentine to secure adhesion. Let the whole rest until the pitch is cold.

To Clean the Speculum.—Place the speculum, cemented to the circular block, face upwards, on a level table; pour on it a small quantity of strong nitric acid, and rub it gently all over the surface with a brush made by plugging a glass tube with pure cotton wool. Having perfectly cleaned the surface and sides, wash well with common water, and finally with distilled water. Place the speculum face downwards in a dish containing a little rectified spirit of wine until the silvering fluid is ready.

To Immerse the Speculum.—Take a circular dish about 3 inches deep, and 2 inches larger in diameter than the speculum. Mix in it the silvering solution and the solution C, and suspend the speculum face downwards in the liquid, which may rise about $\frac{1}{4}$ inch up the side of the speculum. (The silvering will be completed in from 50 to 70 minutes, according to temperature; 50 minutes will be found sufficient in summer.) When the silvering is completed, remove the speculum from the solution, and immediately wash with plenty of water, using at least two gallons, and finally with a little distilled water. Place the speculum on its edge on blotting paper to drain and dry. When perfectly dry, polish the film by gently rubbing, first with a piece of the softest wash-leather, using circular strokes, and finally with the addition of a little finest rouge. A "flat" may be silvered by fastening with pitch to a slice of cork, cleaning as above described, and using as much silvering fluid as will form a stratum about $\frac{1}{4}$ inch deep beneath the mirror.

Professor Kopp.—From a letter just received from Professor Emile Kopp, we understand that he is on the point of quitting Saverne to reside at Turin, where he has been appointed Professor of Technological Chemistry and of Metallurgy in the Royal Museum of Italian Industry. Large laboratories are about to be erected under his superintendence, in which practical work will supplement theoretical teaching. We understand that these appointments have been offered to Professor Kopp by the Italian Government, and he has been induced to accept them in the expectation of having more time at his disposal for original research. After some remarks concerning the *CHEMICAL NEWS*, highly flattering as coming from such an eminent chemist, he promises to forward occasional contributions from his laboratory and records of the progress of science in Italy.

Obituary.—Mr. George Lowe, F.R.S., the eminent Gas Engineer, died on Christmas Day at his residence at Finchley. He was elected an Associate of the Institution of Civil Engineers in 1823, transferred to the class of members in 1829, and for some years was a most useful member of the Council. His name is connected with many improvements in gas engineering, the most prominent being his system of reciprocating retorts and his motive-power metre.

On January 4th the death of JAMES EDWARD FORBES, D.C.L., LL.D., F.R.S., late Principal of the United Colleges of St. Salvador and St. Leonard's, St. Andrews, was announced. The deceased, who was a son of the late Sir William Bart., of Pitsligo, was born in Edinburgh.

educated at the University of Edinburgh, where he obtained several prizes, and where he held the professorship of Natural Philosophy from 1833 till 1860. In 1832 he was elected a Fellow of the Society, and received the Rumford and Royal Medals; he also gained the Keith Medal of the Royal Society of Edinburgh, of which society he was Vice-President. He was the author of a number of works on physical science, as well as of works in various departments of general literature, some of the most noted being "Papers on the Theory of Glaciers," "Norway and its Glaciers," and "Travels in the Alps of Savoy."

Sale of Poisons Act.—A very important act of Parliament—the Amended Pharmacy Act, or Sale of Poisons Bill—came into operation on the 1st inst. By this act it is directed that on and after the 1st day of January, 1869, no poison shall be sold by any person except those registered according to the acts now in force as pharmaceutical chemists, or chemists and druggists; and that every box, bottle, vessel, or wrapper containing poison shall be distinctly labelled with the name of the article, together with the name and address of the person selling the same. A schedule of poisons is given, divided into two sections. All those in section A are strictly forbidden to be sold to any person not known to the seller, unless introduced by some person known to the seller; a register of the sale is compulsory, and must be attested by the signature of the purchaser and his or her witness; while those poisons included in section B need only to be properly labelled. All medicines must be compounded with articles prepared strictly according to the *British Pharmacopoeia*; and every adulteration of any article retailed shall be deemed an admixture injurious to health, punishable under the provisions of the Act for Preventing the Adulteration of Articles of Food or Drink. The poisons defined by this act are—in Part 1, arsenic and its preparations, prussic acid, cyanides of potassium, and all metallic cyanides, strychnine and all poisonous vegetable alkaloids and their salts, aconite and its preparations, emetic tartar, corrosive sublimate, cantharides, safin and its oil, ergot of rye and its preparations; and in Part 2, oxalic acid, chloroform, belladonna and its preparations, essential oil of almonds, unless deprived of its prussic acid, opium, and all preparations containing opium or poppies. Among the preparations which, according to this act, will have to be labelled as a poison, we notice paregoric, elixir, child's cordial, syrup of poppies, and every other syrup, tincture, or lozenge which shall contain the smallest portion of opium or morphia. The object of this bill is evidently to prevent ignorant persons from dealing in articles the composition of which they do not understand. It will also serve as a check to the poisoning of children by the administration of such preparations as child's cordial, soothing syrups, &c. The fine for selling these articles without being properly labelled is heavy, as it is also for selling them without being properly licensed.

The Gas Supply of the City.—In the month of July of last year an important act of Parliament was passed for improving the quality of the gas supplied to the City of London by the several City Gas Companies, and also to those parts of the metropolis supplied by the Chartered Gas Company, whereby the quality of the gas was raised from a standard of twelve candles to fourteen, without increase of charge to the consumer; and with the view of securing the provisions of the act, and enforcing penalties in all cases of default, a chief gas examiner is appointed by the Board of Trade to receive the reports of the daily testings of the gas and to decide all matters of dispute respecting the quality of the gas. It is also the duty of the chief gas examiner to report to the corporation, to the Metropolitan Board of Works, and to the several companies, the quality of the gas supplied during the quarter; and in this capacity, and in accordance with the provisions of the 71st section of the City of London Gas Act, 1863, Dr. Letheby has recently submitted his report to the Corporation of London, from which it appears that since the act came into operation, on the 1st of October

last, the gas of the several companies supplying the city has been tested every night at intervals of not less than an hour between the hours of five o'clock and ten o'clock. The results are as follows:—

Illuminating Power in Standard Sperm Candles.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Co.	16'30	15'99	15'13
The Chartered Gas Light and Coke Co.	16'36	14'13	15'26
The Great Central Gas Consumers' Co.	16'64	13'46	14'90

It appears, therefore, that the illuminating power of the gas has ranged from 13'46 candles to 16'64—the average for the quarter being 15'13 candles for the City Company, 15'26 for the Chartered, and 14'90 for the Great Central. The daily returns show that on three occasions only the gas has been below the standard, and these were no doubt due to causes which admit of satisfactory explanation. With regard to the purity of the gas, he reports that the gas of the Chartered and Great Central Companies has always exhibited traces of ammonia, but that the gas of all the companies has been constantly free from sulphuretted hydrogen. The amount of sulphur present in the gas has ranged from 7'9 grains to 26'52 per 100 cubic feet, the proportion of this impurity being as follows:—

Grains of Sulphur per 100 Cubic Feet of Gas.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Co.	22'28	10'64	16'89
The Chartered Gas Light and Coke Co.	26'52	11'01	21'93
The Great Central Gas Consumers' Co.	24'94	7'90	14'24

The smallest amount of sulphur has been in the gas of the Great Central Company, and this is attributed by Dr. Letheby to the excellent system of purification adopted by that company. The proportions of sulphur have been determined by the instrument known as Dr. Letheby's sulphur test, which is that recommended for use by the gas referees appointed under the act. It is extremely desirable that this impurity should be reduced to the smallest quantity, on account of the corrosive action of the products of its combustion.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Hall, Andersonian University, on the evening of the 21st ult, Dr. Wallace, Vice-President, in the chair. Six members were admitted, and six candidates for membership named. W. R. Hutton, Esq., read a paper on the "Igniting Point of the Vapours of some Commercial Products."

Bust of Dr. Muspratt.—The eminent sculptor, Mr. Adams-Acton, is at present executing a portrait bust, in marble, of Dr. Muspratt, the discoverer of the chloride of iron spring, which is to be placed in the New Pump-room at Harrogate, over the "Dr. Muspratt Chalybeate." The artist hopes to have the bust ready for exhibition at the Royal Academy in May next.

Faraday on the Government Recognition of Science.—The Parliamentary Committee of the British Association applied to Faraday through Lord Wrottesley for his opinion whether any and what measures could be adopted by the Government or the Legislature to improve the position of science, or of the cultivators of science, in this country. He answered:—"I feel unfit to give a deliberate opinion. My course of life, and the circumstances which make it a happy one for me, are not those of persons who conform to the usages and habits of society. Through the kindness of all, from my sovereign downwards, I have that which supplies all my need; and in respect of honors, I have, as a scientific man, received from foreign countries and sovereigns those which, belonging to very limited and select classes, surpass in my opinion anything that it is in the power of my own to bestow. I cannot say that I have not valued such distinctions; on the contrary, I esteem them very highly, but I do not think I have ever worked for or sought them. Even were such to be now created here, the time is passed when these would possess any attraction for me, and you will see, therefore, how unfit I am, upon the strength of any personal motive or feeling, to judge of what might be influ-

ential upon the minds of others. Nevertheless I will make one or two remarks which have often occurred to my mind. . . . A Government should, for its own sake, honor the men who do honor and service to the country. The aristocracy of the class should have distinctions which should be unattainable except to that of science. . . . But, besides, the Government should, in the very many cases which come before it, having a relation to scientific knowledge, employ men who pursue science, provided they are also men of business. This is, perhaps, now done to some extent, but to nothing like the degree which is practicable with advantage to all parties. The right means cannot have occurred to a Government which has not yet learned to approach and distinguish the class as a whole."—*From the Obituary Notice of Faraday in the Proceedings of the Royal Society*, vol. xvii., p. lv.

New Source of Citric Acid.—Professor O. Silvestri, of the University of Catania, has recently discovered a great quantity of citric acid in the fruit of the *Cyphomandra betacea*, a plant belonging to the family of *Solanaceæ* which is found here and there in the gardens of Sicily. It is indigenous to Mexico, and has spread itself into Peru and other parts of South America, where it is called *Tomate de la paz*. It is a woody plant, and attains to the height of 4 metres. On analysis the fruit gives from 1 to 1½ per cent of pure citric acid. This acid, which probably exists also in our edible tomato, has already been discovered by Bertagnini in the potato, and will doubtless be found in all plants belonging to this tribe. —*Cosmos*.

The Preservation of Meat.—The following is a copy of a decree, issued by the Argentine Government, which has been received by her Majesty's Minister at Buenos Ayres, offering a prize of £1,600 to the inventor or improver of the best method of preserving meat:—

"Decree.—Buenos Ayres, Nov. 2, 1868.

"In pursuance of the authority given to the executive power, by the law of the National Congress of the 7th September, to apply the sum of 8,000 hard dollars to a prize, to be given to the inventor or introducer of the system of preserving fresh meat, best adapted, in the judgment of the executive power, to its working on a great scale, the President of the Republic decrees that a term of six months is fixed, reckoning from this date, in order that those who shall consider themselves in a position to try for this prize may present their proposals, within that time, to the Ministry, to be examined in the way the Government may think fit.—(Signed) SARMIENTO DALMATIUS VELEZ SANSFIELD."

Preparation of Nitrogen.—A new and elegant method of preparing nitrogen gas has been devised by an Italian chemist, M. Massimo Levy. It consists in heating bichromate of ammonia in a retort. The salt is transformed into green sesquioxide of chromium, and disengages vapour of water and nitrogen. —*Cosmos*.

American Institute.—The following lectures are in course of delivery at the American Institute:—

Dec. 30, 1868.—Mr. James Hall, State Geologist, Albany; "On the Evolution of the North American Continent."

Jan. 6, 1869.—Professor Horsford, Cambridge, Mass.; "On the Philosophy of the Oven."

Jan. 13.—Dr. T. Sterry Hunt, Montreal, Canada; "On Primeval Chemistry."

Jan. 22.—Prof. Doremus, College of the City of New York; "On the Photometer."

Jan. 27.—Mr. Waterhouse Hawkins, of London; "On Comparative Zoology."

Feb. 3.—Prof. Cooke, Harvard College, Mass.; "On the Spectroscope."

Feb. 10.—W. J. McAlpine, Pres. Am. Soc. of C. E.; "On Modern Engineering."

Reports of those lectures most interesting to our readers will appear in our columns.

The Solar Protuberances.—M. Janssen has forwarded a letter from Simla (Himalaya) to the French Academy of Sciences in which, after giving further particulars respecting his discovery of the visibility of the spectra of the protuberances in full sunshine, he describes an ingenious plan by which he expects to be able to see the actual protuberances themselves at any time. The principle consists in getting one of the luminous lines in the spectral field, and then rapidly rotating the spectroscopic. As the length of the luminous line depends upon the height of that part of the protuberance which it represents, it is evident that the rotation will cause the line to vary with the different widths of the protuberance, and if the rotation is sufficiently rapid, the permanence of the impression on the retina will produce an accurate representation of the protuberance under examination.

Researches on Trimethylbenzine.—This product is obtained by synthesis from xylene and toluene, and the substitution and oxidation products of this compound have been examined. In the same research the presence of mesitylene in mineral pitch, and its production, by the action of liquid chloride of zinc on camphor, is shown. —*Nouv. de Gettingue*.

A New Ventilator.—M. Damoise-Bénard has designed and patented an apparatus for increasing the draught in chimneys, and promoting ventilation. The apparatus consists of a hood, which is placed on the top of the chimney; this hood is movable—that is to say, it rotates upon an axis. In the centre of the hood a narrow tube is fixed vertically; the top of this tube is curved laterally and furnished with a funnel, and after descending a considerable distance into the chimney, it ends in a slightly upward curve. The outer moving portion first mentioned contains numerous lateral openings, protected by wedge-shaped hoods, which prevent ingress of air; there are also four other openings at the top, constructed so as to facilitate egress of air. At the back of the funnel a square piece of metal sheet is attached, to act as a sail. It is scarcely necessary to point out how this apparatus works; the current of fresh air enters the funnel, is obliged to traverse the narrow tube, and creates a current by which smoke and vitiated air are driven out through the openings in the hood. The central narrow tube serves, besides the purposes already described, to balance the hood. According to size, the price of the apparatus is forty, fifty, or sixty francs; the address of the inventor is Rue de Lille, 31, Boulogne-sur-Mer. We understand that the invention is well spoken of by the highest authorities, and is in use in many of the hospitals, bathing establishments, &c., in Paris, Boulogne, and other places.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian University, on Monday, the 18th inst., at eight o'clock in the evening, Dr. Anderson, President, in the chair. Six new members were admitted. A paper was read by Messrs. Bald and Mactear, "On the Salt Deposits of Stassfurt." We hope to be able to give this paper in detail in our next issue.

Testing the Strength of Acetic Acid.—In attempting to determine the strength of acetic acid by means of the hydrometer, it will be remarked that certain anomalies present themselves; thus, there is no difference in the specific gravities of acids containing respectively 53 and 100 per cent. of true acetic hydrate, both having precisely the same density, 1.063, at 60° Fabr. (water = 1.000). The heaviest liquid acid is that containing 80 per cent. the specific gravity of which is a trifle over 1.073; but from this point upwards to the acid of 90 per cent. there is no appreciable difference in the gravity. Again, a sample weighing 1.067 may either represent an acid of 60 per cent. or may contain as much as 98 per cent. of true acid. It is, therefore, customary to guarantee the highest degree of concentration by specifying the temperature at which the acid becomes solid, or, rather, the highest point at which the already glacial

acid resists liquefaction. Another guide which may often prove serviceable in the identification of an acid which, although of a high degree of concentration, is not actually glacial, is the fact observed, we believe, independently by M. Berthelot and Mr. E. Chambers Nicholson, that such acid becomes inflammable when the temperature is raised to the boiling point. If we take, for instance, about a drachm of the acid of 95 per cent and heat it in a test-tube to the boiling point, it will be found that the vapour takes fire on applying a lighted match, and burns steadily as long as the ebullition is maintained; if, however, 10 per cent of water be mixed with the sample, there will be great difficulty in causing inflammation, and the vapour when ignited will only burn with a lambent flame of pale blue separated cones, whilst below this strength the acid vapour is altogether unflammable. By this test, then (avoiding a too-prolonged ebullition, which increases the strength of a weak acid), we have a ready means of estimating the quality of liquid samples of a high degree of concentration without resorting to the more tedious method of acidimetry. It has only to be stated, in conclusion, that the boiling point of the ordinary qualities of acetic acid, although higher, is so little removed from that of water, that the indications of the thermometer are not much more to be relied upon than those of the hydrometer. In many respects carbolic acid imitates the deportment of acetic acid in the characters above described; it likewise becomes glacial upon separation of the least traces of water.—*The Photographic Journal*.

New Alkaloid in Fermented Liquors.—According to M. Oser, every time that solutions of sugar ferment under the influence of yeast, besides alcohol, a new alkaloid is produced, to which the author attributes the formula, $C_{26}H_{26}N_4$. The chlorhydrate of this base crystallises in hygroscopic tables, which become brown on exposure to the air. It appears that all fermented liquors contain the new alkaloid, or at least one of its compounds. We await further information on this subject; the presence of such a substance in wine and in beer, till now entirely unknown, will doubtless explain certain effects of fermented liquors on the animal economy, effects which cannot be attributable to alcohol alone.—*Cosmos*.

Obituary: Baron Von Reichenbach.—This philosopher died recently at Leipzig, aged 81. His researches on the products of the destructive distillation of coal and wood, and his great work on meteorites, are well known to our readers. His investigations on the supposed new *odylic* force, also deserve notice as a remarkable instance of philosophic enquiry applied to subjects scarcely yet within the grasp of scientific reasoning.

How to Make Claret.—At the meeting of the Polytechnic Association of the American Institute on the 7th of January, during a discussion on the adulteration of wines, Dr. Van der Weyde is reported by the *American Artisan* to have described a mode of making claret, viz., by allowing water to soak through shavings, and adding thereto a certain proportion of logwood and tartaric acid. This produced a wine hardly to be distinguished in flavour and colour from claret.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "CHEMICAL NEWS.")

Comptes Rendus, October 5, 1868.

CHEVREUL: "Researches on Experimental Methods in Chemistry." CROUILLER: "On the Dispersive Power of Gases and Vapours." DUMAS: "Note on Drechsel's Method of Preparing Oxalic Acid from Carbonic Acid." M. BOUCHERIE: "Note on the Preservation of Wood." A. HOUZEAU: "On Testing Campeachy Wood and other Dye Stuffs." N. ZININ: "Contributions to the Knowledge of the

Stilbene Series." HIGHTDAHL: "On the Native Alloys of Gold and Silver from the Kongsberg Mine, Norway." A. GACTIER: "On Isopropylcarbamylamine and Isopropylamine." J. NEY: "A New Galvanic Battery."

October 12, 1868.

E. FRANKLAND: "On the Combustion of Hydrogen and Carbonic Oxide in Oxygen under a High Pressure." J. KOLB: "Memoir on Bleaching Fabrics." G. RAYET: "On the Spectrum of the Protuberance observed during the Total Eclipse of the Sun of August 18, 1868, at Malacca." J. CLOUET: "On Chromite of Iron." E. PATERNO: "On the Acetal of Trichlorinated Ethyl, and on the Preparation of Chloral."

October 19, 1868.

DUMAS: "Note on a Decision of the Academy relating to Memoirs on Squaring the Circle, Duplication of the Cube, Trisection of the Angle, and Perpetual Motion." WARREN DE LA RUE and H. MULLER: "On a New Constant Battery." RAPATEL: "Report on the Eclipse of the Sun of August 18, 1868, from Observations taken between Madras and Calcutta." A. GAUTHIER: "On the Oxidation Products of Carbylmines." DE SAINT-MARTIN: "On the Density of Saline Solutions."

Bulletin de l'Académie Impériale des Sciences de St. Petersburg,
June 4, 1868.

P. KOSYTSCHOFF and O. MARCGRAV: "On the Chemical Composition of the Fossil Sponges of the Apatites of the Cretaceous Beds of Russia." N. ZININ: "Note on Chloro-benzil." DUKE NICOLAS VON LEUCHTENBERG: "Note on Kotchoubette, Kammererite, and Pennine." H. JACOB: "On the Electro-Deposition of Iron." KLEIN: "On the same subject." O. STRUNK: "On the Spectrum of the Aurora Borealis." A. FAMINTZIN: "On the Action of Light on Cell-digestion in Spirogyra."

Annales de Chimie et de Physique,
September, 1868.

P. AUDOUIN: "On the Use of Liquid Hydrocarbons for obtaining High Temperatures and for Heating Steam Boilers." A. RENARD: "On the Volumetric Estimation of Zinc." E. BOURGOIN: "On the Part taken by Water in Electrolysis." A. MARTIN: "An Improved Process for Silvering Glass by means of Inverted Sugar." P. SCHUTZENBERGER: "On some Reactions producing Oxichloride of Carbon, and on a New Volatile Platinum Compound." DE LAPPARENT: "Report on Pasteur's Method of Preserving Wine by means of Heat." P. SCHUTZENBERGER: "Memoir on the Colouring Matters extracted from Persian Berries."

Bulletin de la Société Industrielle de Mulhouse,
July, 1868. Supplement.

J. KOLB: "Memoir on Bleaching Fabrics." H. KOCHLIN: "On some Mordants, other than Alumina and Iron, for Garancine Colours, with especial reference to a new Red (grenat) Dye obtained with Chromium." A. SCHEUREN-KESTNER and C. MEUNIER: "Researches on the Combustion of Coal." C. KOCHLIN: "A Process for Extracting the Colouring Matter from Waste Fabrics Dyed with Garancine." M. PARAF-JAVAL: "Note on a Method of Preventing the Injurious Action of Aniline Black on the Copper of Printing Rollers." SCHNEIDER: "On the same subject." MARNAS: "A New Aniline Dye."

Comptes Rendus, October 26, 1868.

J. JAMIS: "On a Differential Refractor for Polarised Light." A. GIRARD: "On a New Volatile and Saccharine Principle Discovered in Caoutchouc from the Gaboon." A. BECHAMP: "On the Decomposition of the Sulphides of the Alkalies and Alkaline Earths by Solution in a Large Quantity of Water." WARREN DE LA RUE: "On the Method employed by J. N. Lockyer for obtaining Spectra of the Protuberances observed during Total Eclipses of the Sun." JANSSEN: "Note on some Results of the Author's Observations of the Total Eclipse of the Sun of August 18, 1868, at Guntur, India." FAYE: "Note à propos of the Two preceding Papers." BERTHELLOT: "On the Formation of Homologues of Benzene by the Reciprocal Action of Free Hydrocarbons of more simple Structures. On the Carbonaceous Matter contained in certain Meteorites."

November 2, 1868.

DELAUNAY: "On the Discovery of a Method of Observing Solar Protuberances at all times." E. PELIGOT: "On the Composition of the Chromites of Iron." S. MEUNIER: "Analysis of a Meteorite." C. MARIGNAC: "On the Latent Heat of Volatilisation of Sal-Ammoniac." F. JOLYET and A. CAROURS: "Researches on the Physiological Action of Methyl-strychnine and Ethyl-strychnine." C. GLASER: "On Acetyl-benzene, a new Hydrocarbon of the Aromatic Series." S. DE LUCA: "Chemical and Therapeutical Researches on the Waters of the Solfatarae Pouszales." E. GILLES: "A Method of Classifying the Elements based upon their Chemical Equivalent."

Bulletin de l'Académie Impériale des Sciences de St. Petersburg,
August 12, 1868.

F. BEILSTEIN and A. KUHLEBERG: "On Substituted Alcohols and Aldehydes." E. NEUBER: "On some Derivatives of Para-Chlorobenzyl Alcohol." J. FRITZSCHE: "Researches on Hydrocarbons." N.

ZINZ: "On a Product of the Action of Hydrochloric Acid on Essence of Bitter Almonds containing Hydrocyanic Acid."

Annalen der Chemie und Pharmacie. October, 1868.

R. FITTIS and J. VELGUTH: "Researches on Mesitylene. Fifth Memoir: On Isosylol, a new Hydrocarbon Isomeric Xylol." L. BARTH: "Researches on Oxybenzoic Acid. Note on a Compound of Phenol with Carbonic Acid." L. CARIUS: "A New Synthesis of the Aromatic Acids." A. STRECKER: "On Lecithine. On a new Mode of Formation and on the Constitution of Sulpho-Acids." K. BENDER: "On a new Mode of Formation of Sulpho-Ethyllic and Disulpho-Ethyllic Acids." A. COLLMAN: "On a new Mode of Formation of Sulpho-Methyllic, Isethionic, and Sulpho-Acetic Acids." A. SCHAUFELIN: "On the Sulpho-Acids of Glycerine." L. DARMSTADTER: "On the Relative Constitution and on some Metamorphoses of Epichlorhydrin."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
July, 1868.

E. WIEDEMANN: "On the Magnetism of Chemical Compounds." A. W. HOFMANN: "Contributions to the Knowledge of Guanidine. Compounds Isomeric with the Sulphocyanic Ethers.—II. Homologues and Analogues of Ethylic Mustard Oil."

Journal für Praktische Chemie.
October 17, 1868.

G. WEERTHER: "An Analysis of the Meteorite which fell at Pullu, Russian Poland, on the 30th of January, 1868." J. LOWE: "On the Preparation and Composition of Catacholic Acid."

Comptes Rendus. November 9, 1868.

A. W. HOFMANN: "On the Compounds Isomeric with the Sulphocyanic Ethers."—Homologues and Analogues of Oil of Mustard of the Ethylic Series.—SACHS: "Note on Solar Protuberances."—JAMIE: "On the Theory of Scintillation."—CHEVREUL, on the same subject. FIEAU: "Note on A. J. Angström's Maps of the Solar Spectrum."—J. N. LOCKYER: "Further Remarks on the Author's Method of obtaining Spectra of the Solar Protuberances."—F. M. RAOUlt: "On the Effect of a Rise in Temperature on the Colorific Phenomena accompanying Electrolysis."—BERTHELOT: "On the Pyrogenous Formation of the Acetylene of the Benzol Series."—LEFRANC: "On Atractylic Acid and the Atractylates, some new Products extracted from *Atractylis gummifera*."—G. FLEURY: "A Method of Preparing Emetics and other Double Tartrates."—A. COMMAILLE: "On the Presence of Creatine in Purified Whey."

November 16, 1868.

A. W. HOFMANN: "On the Compounds Isomeric with the Sulphocyanic Ethers."—Comparison of the Metamorphoses of Oils of Mustard and of the Sulphocyanic Ethers.—WARREN DE LA RUE: "Note on a Photograph of the Sun."—A. SCHEUREN-KESTNER and C. MEUNIER: "Researches on the Combustion of Coal" (Continuation).

Bulletin de l'Académie Royale de Belgique. (Classes des Sciences.)
October 10, 1868.

STAR: "Report on B. Radziszewski's Memoir on some Derivatives of Phenyl-Acetic Acid."—B. RADZISZEWSKI: "Researches on some Derivatives of Phenyl-Acetic Acid."—C. BLAS: "On the Fluorescent and other Properties of Murrayine, a new Glucoside obtained from *Murraya exotica*."

Poggendorff's Annalen der Physik. October 12, 1868.

C. CAPE: "On the Thermal and Chemical Axes of Gypsum and Sulphate of Copper."—E. WARRBURG: "Observations on the Influence of Temperature on Electrolysis."—W. BRETT: "On the Electric Vibration-Chronoscope."—PINOUS: "On a New Constant Voltaic Battery."—A. WOLNER: "A Method of obtaining an Artificial Spectrum with a single Fraunhofer's Line."

NOTES AND QUERIES.

Frosting Glass.—I should esteem it a great favour if you would give the method of frosting flint glass by the liquid as it is done on the Continent and in Stourbridge. I can do it with the fluoride of ammonium and hydrofluoric acid mixed together; the fluoride does not mix with the acid, so I have to put it on with a brush, and it is very uneven and patchy. Perhaps some of those learned chemists who are connected with your valuable paper might be able to instruct me so that I could do it practically. There is a way to do it with the fumes, but it is a very old way and a very bad way, and so very unhealthy.—R. B.

The Lines in the Spectrum.—Several years ago, when Bunsen and Kirchhoff were in Paris, Plucker and Runkel proposed to them a difficulty in "Spectrum Analysis," which they did not answer. I have long been waiting to see an answer. The difficulty is one which meets a person at his first trial of a spectroscopic. It is this:—The vapour

spectra are bands, not lines, like Fraunhofer's, and these bands vary in width with the opening of the slit. Take, e. g., sodium. A candle held in front of the slit gives a variable band, not a line or pair of lines. It is not possible but that this difficulty has been most fully explained; but I have not been able to obtain explanation or conquer the difficulty with a plain spectroscopic. The sun lines are quite easily had, even with a common prism in the hand; not so vapour lines.—E. K.

Vitriol Chamber.—What is the best shape for a vitriol chamber, and on what does the yield depend? I wish to know whether a chamber of the shape of a cube would yield as much as a longer and narrower one of the same contents?—G. N.

Siam.—Your correspondent, "Oriens," who desires information about the kingdom of Siam, will, perhaps, most readily obtain the information he requires by either politely addressing the Right Hon. Sir J. Bowring, who, according to the "Almanach de Gotha" for 1869, is the Envoy Extraordinary and Minister Plenipotentiary for Siam to the Court of St. James, or by applying to D. M. Mason, Esq., Consul for Siam, residing in London.—D.

Vitriol Chambers.—"G. N." wants to know the best shape for vitriol or sulphuric acid chambers. Without entering into details concerning the theory and practice of the manufacture of sulphuric acid, full particulars of which are given in Richardson, Watts, and Knapp's "Technology," it may be briefly stated that the shape usually adopted has been found to answer the purpose best, because it best admits the proper play of reactions to take place between the various materials, which results in the formation of sulphuric acid; if, instead of sulphur, sulphur ores (pyrites) are used, the capacity of the chambers should be relatively larger to obtain the same quantity. The shape adopted for sulphuric acid chambers has been found on experience to be not only the most suitable, but the only one practically suitable for success on the large scale.—DA. A. A.

Ice House.—Will any person acquainted with the subject, kindly furnish me with a description as to the best method of constructing an ice house on a small scale?—ZREO.

Dynamite.—Your correspondent, Mr. Wheeler, will perhaps be glad to learn that dynamite may be obtained from Messrs. Webb & Co., Carnarvon, N. Wales, the sole consignees in England from the patentee and manufacturer.—ALPHA.

Separating Iron and Brass Dust.—We wish to know the name and address of the patentee (or the maker) of an electro-magnetic apparatus for separating iron from brass dust. The name of any firm using one will answer our purpose as well as we wish to make enquiries as to the capabilities of the apparatus.—HIBBERT & CO.

Separating Iron and Brass Dust.—Certain improved apparatus for separating filings or other small bits or particles of iron or steel from other metallic filings, scrapings, chippings, or other small particles or dust, by use of magnets. Patentee, William Thomas Bissell Alday; No. of Patent, 67; date, January 10th, 1860. Address, Rednall, Worcestershire.

Ice House.—"Zero" may find a very good account of the mode of constructing an ice house in Ure's "Dictionary of Arts, Manufactures, and Mines," published by Longmans, sixth edition, vol. ii, p. 643. The article is accompanied by a wood-cut, and is too lengthy to be properly abstracted in "Notes and Queries;" the work alluded to is found in the Library of the Commissioners of Patents.—ALPHA.

The New Petroleum Act.—Can any of the numerous correspondents of the CHEMICAL NEWS tell us if benzol comes under the operation of the act? If it does, it will affect us rather seriously. We presume ether is not included.—A WHOLESALE FIRM.

Manufacture of Iron.—A new process for the manufacture of iron, whereby the puddling process is obviated, is now on its trial at Pittsburgh, U. S. The pigs of crude iron are melted, and while in a fused state, a quantity of crushed ore is intermixed. The oxygen of the ore combines with the carbon of the iron; the mixed mass is called a pig bloom. Upon reheating these pigs and squeezing them in the usual manner, iron of very good quality is obtained.—ENGINEER.

Chromium Steel.—It has long been known that an alloy composed of sixty parts of chromium and forty parts of iron is so hard as to scratch glass like a diamond, and such an alloy may be formed by heating oxide of chromium and also chrome iron ore in a blast furnace; if the oxide alone be applied, metallic iron, of course, should be added. Experiments on the large scale are now being carried on to produce a species of steel, suitable for rails and other purposes, by adding chrome ore and manganese to the iron in the puddling furnace.—ENGINEERING.

Colouring Zinc.—Zinc may be given a fine black colour by cleaning its surface with sand and dilute sulphuric acid, and then immersing it for an instant in a solution composed of four parts of sulphate of nickel and ammonia in forty parts of water acidulated with one part of sulphuric acid, next washing and drying it. The black coating adheres firmly, and takes a bronze colour under the burnisher. Brass may be stained black with a liquid containing two parts arsenious acid, four of hydrochloric acid, one of sulphuric acid, and eighty of water.

Preservation of Wood.—According to statements made by Dr. Feuchtwanger, of New York, who for the past thirty-six years has had his attention directed to the preservation of wood from every species of decay, and also to make it incombustible or fire-proof, not one single process attempted for this purpose has been attended with permanent success, except the application of silicates in their various forms to all organic substances, such as woody fibre, pasteboard, &c. Dr. Feuchtwanger's method is simply to steam the timber, then inject a solution of silicate of soda for eight hours, and then soak the wood for the same period in lime water.

The Specific Gravity of Steel oscillates between 7.2 and 7.9. The hardening of the metal by tempering is accompanied, as Réaumur long ago observed, by a notable diminution of specific gravity, and Caron has noted that the specific gravity of steel diminishes with the number of times it is tempered.

ANSWERS TO CORRESPONDENTS.

J. N. F.—There is danger of the subject of Science Teaching becoming wearisome to our readers.

E. K.—1. The new edition of Fownes's "Manual" will prove very useful in addition to Miller's "Chemistry." 2. See Notes and Queries.

Josephus.—Add hydrochloric or sulphuric acid to a strong solution of the salts. Benzoic acid will be precipitated, as it is much less soluble in water than succinic acid. The dry acids may also be separated by taking advantage of their different volatility.

J. Walton wishes to know of a book on colour making, applicable to the artists' colour business.

J. Wood.—1. We are not aware of any special work on the subject. 2. The best book on analysis is Fresenius's.

A Constant Subscriber.—Solid carbonate of ammonia will answer all your requirements.

J. Hardman.—Messrs. Truman, Hanbury, Buxton, and Co. have one of the ice machines you mention. One of 18-horse power would cost £2,000.

Mr. Bassett's communication "On a Mercury Compound of Acetylene," together with those of several other correspondents, are unavoidably postponed till next week.

Querist.—One part of sulphur will dissolve in about 2,000 parts of glycerine, and we believe the solution has been proposed as a local application in some affections of the skin.

Oriens asks "whether there is, in the service of the Siamese Government, any opening for a technological chemist experienced in the analysis of soils, ores, furnace products, and drysalteries, and if so, what would be the channel for an applicant to offer his services?" Perhaps some of our correspondents may be able to answer this inquiry.

J. Wallace.—The *Bulletin de la Société Industrielle de Mulhouse* can be obtained through any foreign bookseller, or it can be seen at the Patent Office Library, Chancery Lane.

Dr. J. Hirsch.—Our correspondent's communication on "Carbolic Acid" is duly received, and shall be inserted in an early number.

R. F. Wheeler.—Messrs. Prentice and Co., Stowmarket, supply all the preparations of gun cotton. We are not able to inform you where dynamite is to be procured.

C. Horner.—1. A Bunsen burner is preferable to a spirit lamp for experiments in spectrum analysis. If you require more heat, use a fine, blow-pipe flame, but nothing will replace the induction coil for experimenting on many metallic compounds. 2. In making oxygen from manganese and chloride of potash there is no danger provided the exit pipes are wide enough to avoid getting blocked up. 3. A glass retort will not do to decompose binoxide of barium in by heat.

J. Brode & Co.—There will be no loss of delicacy if you replace the steel knife edges of your balances by agate. We have used agate edges on agate planes for years, and prefer them to steel on agate, as they do not deteriorate in a laboratory. The shape of the knife edges is the same in each case. You will find it advisable to have the alteration done by a workman experienced in the manufacture of balances, as they will be sure to require readjustment.

C. R.—To ascertain the composition of the substance forwarded to us would involve a chemical analysis.

S.—1. Apply to Messrs. Johnson and Matthey. 2. Consult C. Neill's "Dictionary of Calico Printing."

Per Mare Per Terram.—An "assay centner" is an indefinite technical term. It means 100 units of weight. In copper assays, for instance, the centner is frequently 400 grains.

T. Thompson.—Phosphate of lime is decomposed by ebullition with an aqueous solution of oxalic acid. Probably this reaction will be of use in your research.

A. M. Edwards.—1. The presence of alkali prevents iron from rusting, and this fact is frequently made use of, but we have not seen any satisfactory explanation of the circumstance. 2. Thallium and its salts can be procured from Messrs. Hopkin and Williams, New Cavendish Street, London, W. 3. There is only one copy of vol. ix. at our office; its price is 30s.

G. F. R., and others.—It is gratifying to know that the alteration of type which we have introduced with Dr. Odling's Lectures gives such satisfaction. The font, which has been specially cast for us, is particularly legible, retaining all the picturesque quaintness of antique style with the mathematical accuracy which characterises modern type.

The Royal Astronomical Society.—The following startling news appears in a contemporary:—"The announcement has recently been made to the Royal Astronomical Society of England of the discovery, by means of the spectroscopic, of a hitherto unknown envelope of gaseous matter surrounding that body, of a thickness of seven or eight thousand miles. Its precise composition has not yet been determined, but will probably before long be ascertained." It is to be hoped that immediate steps will be taken to rescue the Fellows of this learned body from their perilous position.

Professor Atfield's communication "On the Igniting Point of Petroleum" is unavoidably postponed until next week.

C. Hunter.—One cell of a battery will not efficiently decompose water; you will require two or three cells at least. If the zinc plates are properly amalgamated there will be no frothing in the cell.

J. W. C.—We cannot undertake the responsibility of saying whether any particular individual is a "respectable practitioner" or an "advertising quack." As a rule, respectable practitioners do not advertise.

F. D.—We know of no book which treats on the formation, fitting-up, and management of a laboratory. Much depends upon the kind of work to be done in it; whether research, or commercial analyses; how many assistants are employed, and if pupils are taken. Length of purse is also an important consideration. As you say expense will be no con-

sideration, the best plan will be to see as many private and public laboratories as possible, select the most useful points from each, and then draw out a plan for yourself. You will find it advantageous to consult Greville Williams's "Handbook of Chemical Manipulation" before deciding about the final arrangement.

Reprints of our Early Numbers.—In deference to the wishes of numerous subscribers, we have decided to reissue many of our earlier numbers which have long been out of print, and in this manner we shall shortly be able to supply all the earlier volumes. No. 3, December 24, 1859, will be ready for issue in about a week's time.

A. W. A.—We cannot recommend any particular chemist in this column. Send a private address, with particulars, and we will communicate with you.

W. Cass.—The whole of the information you require respecting the best and most modern works on iron, its nature and working, &c., will be found in the second volume of Kerl's "Metallurgy," which will be published in the course of a month or two by Messrs. Longman.

Phosphoric Acid.—A correspondent who makes some remarks on this subject, is informed that his letter is so badly written as to be almost unintelligible. The signature is hopelessly involved in flourishes, and it is only here and there that a word can be deciphered.

F. D.—Besides the works quoted last week, there are several others, chiefly in the German language, giving descriptions of laboratories. There are, for instance, descriptions of the laboratories of Glessen, Carlsruhe, Prague, Upsala, Dorpat; in the German edition of Mohr's excellent work *Pharmaceutische Technik* an entire chapter is devoted to the subject of arranging and fitting up a laboratory, while Dr. Adolf Duflos, of Breslau University, has also written and published a small, but very excellent, work on this subject.

Communications have been received from Dr. Angus Smith, F.R.S.; S. Wilson; Dr. Odling, F.R.S.; Grimwade, Kidley, and Co.; J. B. Sawyer; J. L. Sinclair, Auckland, N.Z.; W. T. Suffolk; T. Dicker; Messrs. Townsend and Adams; F. B. Baker; R. Broadhurst; J. Wood; J. F. Sprague; Marshall Hall; Dr. H. Bence Jones, F.R.S.; H. Bassett; J. Watson; R. E. Tatlock; E. Kernan; the Prior of the Monastery of St. Joseph (with enclosure); J. Pryde; J. Mackie; Corbett and Wood; B. Nickels; U. J. Kay-Shuttleworth; W. J. Bush and Co. (with enclosure); W. T. Suffolk; H. Sanders; G. Harrison; J. Dicker; W. Salter; Dr. Letheby; O. Richter; J. Wilson; E. Kopp; L. Cookson (with enclosure); J. Pride (with enclosure); S. R. Muspratt; T. Vosper; A. N. Tate; T. Watts; J. Parnell; Dr. R. Angus Smith; Rivington and Co.; W. McNamara; J. A. Brand; D. Forbes, F.R.S.; G. Young (with enclosure); D. W. Ladley; J. W. Sugg; C. K. Jewett, Göttingen (with enclosure); Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; S. Mellor; W. T. Suffolk; G. Ford; G. Harrison; R. F. Wheeler; G. Wharton Simpson, M.A.; Dr. Sheridan Muspratt; Dr. Joseph Hirsch, Chicago; J. Wallace; Messrs. Muir, Brown, and Co.; C. Horner; Dr. Otto Richter; J. Brode and Co.; Dr. E. Rohrig; R. E. Tatlock; E. C. Stanford; J. Morris (with enclosure); W. Briggs (with enclosure); R. Mallet, F.R.S.; Stanislas Meunier; J. and E. Sturge; J. A. Brand; M. A. Gage; G. Maxwell; Muspratt, Bros., and Huntley; A. Hedley; T. Blair; C. Barrett (with enclosure); J. Morris (with enclosure); J. Wallace (with enclosure); Professor Wanklyn; R. Mallet, F.R.S.; W. T. Suffolk; E. Stanton; Professor A. M. Edwards, New York; W. Little; Hibbert and Co.; E. P. H. Vaughan; J. Salter; J. Spiller; M. L'Abbé; A. Hamy; G. Keyworth; E. Pocknell; Messrs. Townsend and Adams; E. W. Ball; J. F. Dickson; C. K. Jewett, Göttingen (with enclosure); B. Sulman; J. J. Ward; Rivington and Co. (with enclosure); A. F. Francis; Dr. Wallace (with enclosure); J. Solomon; B. Nickels; Gaskell, Deacon, and Co.; G. F. Rodwell; J. Hughes; T. Ludwig, Suez, Egypt; W. M. Watts; Professor Rudolph Fittig (with enclosure); Dr. S. Muspratt; Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; H. Benschaw; E. Hart; J. W. Clements; R. Mallet, F.R.S.; G. Hunter; J. Samuelson; W. T. Suffolk; Professor R. Fittig; M. Aguilarg; G. Henry; A. M. Scott (with enclosure); A. Wuth (with enclosure); H. McLeod; A. N. Palmer; J. C. Lee (with enclosure); Dr. Noad; B. N. Shaw; Mottershead and Co. (with enclosure); B. R. Tatlock; Dr. Odling, F.R.S.; T. Hill; J. Spiller; D. Saul; and Professor Church; A. Freire Marreco; R. Mallet, F.R.S.; R. Carter Moffat; C. Griffin & Co.; S. Mellor; O. Greville Williams, F.R.S.; Dr. Adriani; W. Palmer; H. Russell; J. E. Morgan; Dr. Letheby; E. Blackwell; W. Sydney Gibbons, Melbourne; R. C. Clapham; Clark and Company, Melbourne; Professor Horsford; R. R. Tatlock; W. Cass; Archibald Walker & Co. (with enclosure); Mawson & Swan; J. S. Brazier; F. Baden Benger; H. Hudson (with enclosure); A. Deiss (with enclosure); J. Hopkinson (with enclosure); Rev. R. C. Jones (with enclosure); Sturge & Co.; E. A. Sturman; The Kew Observatory; A. Geyger; W. Browning (with enclosure); Runcorn Soap and Alkali Co.; J. Turner (with enclosure); and W. Little (with enclosure).

Books Received.—"Histoire des Doctrines Chimiques, Depuis Lavoisier jusqu'à Nos Jours." Par Ad. Wurtz. Paris: L. Hachette and Co.—Tweedie's "Temperance Year Book of Facts and History." London: W. Tweedie.—"The Journal of Materia Medica." New Lebanon, N. Y.: Tilden and Co.—The "Photographic Journal." No. 201, vol. 13.—"Report of Annual Meeting of Members of the Lincolnshire Farmers' Association."—Van Nostrand's "Eclectic Engineering Magazine." No. 1, vol. 1.—"Town Life among the Poorest: the Air they Breathe and the Houses they Inhabit," by John Edward Morgan, M.A., M.D., Oxon. London: Longmans, Green & Co.—"Report on the Sanitary Condition of the City of London for the year 1867-68," by H. Letheby, M.B., M.A., Ph.D., &c.; The American Journal of Science, January, 1869.

AMERICAN SUPPLEMENT.

New York, March, 1869.

The Cracking of Oils.

TO THE EDITOR OF THE SUPPLEMENT—In your issue of the present month, I find a criticism of my article on the Distillation of Hydrocarbons at high temperatures, etc., which appeared in the January number of the *American Journal of Science*.

I take no exception to the criticism, as an expression of the individual opinions of the author, either in its remarks upon the style or subject-matter of my paper; and I am only led, in the present instance, to notice it from fear that by my silence I might be understood to assent to the opinions therein expressed. It is but justice to myself to say that the article of seven pages was not wholly, or in large part, devoted to a criticism of the theory of Dr. Hirsch, as the review would lead one to suppose. It is, to an equal extent at least, employed in a description of experiments the results of which had never before been published, which bore directly upon the subject, and formed the most conclusive evidence upon which I formed opinions differing from those of Dr. H. Moreover, the article in question was not simply an expression of one individual opinion or theory as opposed to another; but, in addition thereto, it contained a description of experiments the results of which were impossible of explanation upon the opposed hypothesis, viz., that of Dr. Hirsch.

But, as my reviewer says, "the substance is of more importance than the form," and to the substance of his remarks in the fourth paragraph of his article I most emphatically object. I do not desire "credit for knowing better" than to repeat the statement that the process of "cracking" Pennsylvania or any other crude oils consists in subtraction of carbon.

Four series of homologues are thus far known as the possible volatile products of "cracking," with a few isolated bodies like naphthalene and the more dense products entering into the composition of coal tar, which have thus far been but little studied. The first two of the four series have been named by Professor Dana the "Naphtha" and "Beta-naphtha" series. They are isomeric, and their composition is represented by the general formula C_nH_{2n+2} being homologues of marsh gas, CH_4 .* The third series consists of the Olefines, or Pittoleum Group of Professor Dana, and their composition may be represented by the general formula C_nH_{2n} , being homologues of olefiant gas CH_2 . The fourth series is the Benzole series, represented by the formula C_nH_{n-6} . This last group, together with the coal tar products mentioned, may be considered as forming with the coke the less volatile and more highly carbonized residue of the "cracking" of bituminous coal, while the large volume of gas, containing a much greater number of equivalents of hydrogen than of carbon, escapes as the distillate. That "cracking," in this instance, consists of subtraction of carbon, I think no one will deny.

In the many experiments made by myself, I have not, however, yet observed that these coal tar products are found among the products derived from petroleum by "cracking."

Although I do not agree with my reviewer that Warren's apparatus is the one "least suitable for

petroleums," I will suppose that it be admitted that petroleum fractionated by it are more or less "cracked." The conclusion inevitably follows that the products of "cracking" are chiefly formed on the marsh gas type, and belong either to the Naphtha or Beta-naphtha series. The amount of carbon varies in this class of bodies from eighty-five per cent in solid paraffin, to seventy-five per cent in marsh gas, the proportion decreasing as the density decreases. I think that no one can deny that "cracking" the more dense members of this series must result in subtraction of carbon.

There only remain the olefines, with a constant formula C_nH_{2n} . Each member of this group has the same percentage composition of carbon and hydrogen as the others, viz., eighty-five and seven-tenths per cent of carbon, and fourteen and three-tenths per cent of hydrogen. The density of the different members depends upon complexity of molecular arrangement. It is evident that "cracking," in this series, might result only in a re-arrangement of atoms to form less complex molecules, without subtraction of carbon; but, if the members of this group were "cracked" into those of the marsh gas series, deposition of carbon must follow.

I grant that chemists know comparatively nothing regarding the more dense portions of Pennsylvania petroleum, and other kindred substances, to the treatment of which the process of "cracking" is applied. What is known, however, points to the supposition that those substances containing paraffin contain the olefines in comparatively small volume, while those like California petroleum, which do not contain paraffin, are, in all probability, made up chiefly, if not entirely, of olefines, or some other more highly carbonized series. This supposition is strengthened by the fact that the distillate from California petroleum of the same density as the commercial oils manufactured from Pennsylvania petroleum does not burn as well with the same draft, and evidently contains more carbon than those oils.

Now, one experiment is worth more than volumes of speculation. I have shown that homologues of marsh gas cannot be "cracked" without subtraction of carbon; and also, that, if the members of the Benzole series are formed at all (as they may be, towards the close of the operation), they are rather to be classed with the more highly carbonized residue than with the more highly hydrogenized distillate. In all of the many experiments made by myself upon California petroleum, not one instance of "cracking" occurred without deposition of carbon, and the distillate no longer appeared to contain an excess of carbon, but resembled, in physical properties, the ordinary distillate from Pennsylvania petroleum. I think, therefore, that, in the light of both theory and experiment, I hazard nothing in repeating the statement that the process of "cracking" consists essentially in subtraction of carbon, and not in a change from a more to a less complex molecular arrangement.

In reference to the problem proposed, I think it will require very little study to convince a candid mind that the essential conditions are impossible of occurrence. Is it possible that air should enter the interior of the still through the worm, against the pressure of the ascending vapors? Again, if water is produced during the distillation of a pure hydrocarbon, it must be by combustion of the hydrogen. If it were possible, does any of my readers suppose that any dis-

tiller would allow air to enter the interior of his still a second time, in sufficient quantity and at such a temperature as to produce combustion of the hydrogen? Whoever found water in his distillate, either put it into his still or had a leaky condensing apparatus. The presence of the deposit resembling albertite was simply due to the fact that the operation was suspended before all of the volatile products had escaped. In the many distillations that I have made of a great variety of bituminous substances, the residue has varied in appearance from that of the hard, difficultly combustible coke of the gas retorts to the ordinary tarry residue of Pennsylvania petroleum.

Very respectfully yours,

S. F. PECKHAM.

Professor of Applied Chemistry in Washington
and Jefferson College, Washington, Pa.

February 23, 1869.

[Our readers are indebted for the above interesting paper, in part at least, to a little misapprehension, by its author, of what we intended in our remarks in the February issue. We asserted that "cracking" does not consist in the subtraction of carbon, meaning thereby that the taking away of carbon did not comprise the whole of the chemical change. Prof. Peckham's expression conveyed to our mind the idea of a molecule of hydrocarbon being changed only by lessening the amount of its carbon,—a theory which surely does not cover the whole case. If the three articles in question be compared, it will be found that the differences of opinion are far less than would be inferred from reading only the last; the differences are much less than the coincidences. In short, with a little softening of the style of putting things, Prof. Peckham and the editor would appear to be fast allies. We begin to think that manner often approaches in importance to substance; our philosophy is often too positive.—Ed.]

The New Oxygen Process—An Apology "Just Once."

We are sorely grieved that our worthy brother of the *American Journal of Mining* is not content with our efforts at furnishing chemical news. He scolds us roundly because we have not given the latest news concerning the manufacture of oxygen in this city, and he finds us, touching this case, "sadly behind the times." But he kindly suggests, "In default of better means for avoiding such an unfortunate oversight in future, let him" (meaning the writer, of course) "provide himself with the *Journal of Mining* and a pair of scissors." We are grateful enough for the evident good intention of the advice, but in justice to ourselves we think it ought to be made known that we have always held in the very highest esteem the *Journal of Mining* and scissors as assistants in performing our duties. We have been among the constant readers and admirers of the *Journal of Mining* since its very first; for years two copies of it have come weekly to our office, and we are lavishly provided with scissors, for they are our favorite and trusty companions. We really and honestly have found no news about the oxygen process in the *Journal of Mining* except that which appears simultaneously with the complaint against us; if it had been printed there we do not see how it could have escaped our scrutiny and our scissors. We protest, therefore, that our brother is a little hard on us; let it be remembered that we are only a Supplement, barely four

months old. We might say other things in deprecation of future censure, but we must not longer detain our readers from the momentous news of the oxygen process; we will not omit a syllable of it:

"About a year ago a company was formed in New York, which is now successfully introducing to general use the oxyhydrogen light, having overcome the difficulty hitherto attendant upon that light, namely, the great expense of the oxygen gas. The process employed is founded on the discovery that manganate of soda, when steam is passed over it, will give off pure oxygen, and, when air is subsequently passed over it, will reabsorb oxygen from the air, and that this alternation may be repeated indefinitely. Works have been erected, in which oxygen is manufactured at little more than the cost of common street gas. By the use of common gas and oxygen in a burning jet thrown upon a small cylinder of magnesia or lime, a light may be produced far exceeding in brilliancy that of the same amount of street gas burned in the usual way; and this process therefore promises a great and sweeping improvement in the illumination of buildings, streets, etc. The principle of the light is not new; it is identical with that of the so-called calcium or Drummond light; but the discovery by which the oxygen is so cheaply manufactured renders it applicable on a large scale for all sorts of purposes.

"In view of this great and much-talked-of discovery, already introduced into practical use in this country, though originating in France,"—here he scolds us, and gets the laugh on us. A little further on he sets forth the rapid coming into use of oxygen, by reason of its cheapness, affirming the Toodles principle of political economy, that the supply regulates the demand, and continues: "In truth, the new process to which we have alluded leaves little more to be expected in that direction. It surpasses the most sanguine hopes of its projectors, and satisfies every requirement of a cheap, continuous process—the closest imitation of Nature's own alternate oxidations and reductions. The productiveness of the process even improves, the longer the apparatus is kept in operation—a point which we will not here pause to explain." And then he puts in another blow. Here ends the complete and authentic narrative; and at last the readers of the SUPPLEMENT are only a few weeks behind the readers of the *Journal* in getting it.

There are very few questions which have only one side, and it happens that we have a little to say by way of exculpation for our neglect. Our readers have a right to know why it has happened that a paper not specially devoted to chemistry has beaten us on our own ground. Therefore we present the following statement and plea in extenuation and for mitigation of punishment, and then, as a lawyer advises us, we shall throw ourselves upon the country:

As soon as the agents of the French process were publicly known to be in the city, we called on them at their office, and found them polite, like all Frenchmen, while at the same time they freely and fully answered questions. This was early last summer. We were instructed in detail, by the use of a handsome model of furnace, &c., how they proposed to manufacture oxygen, by (1st) setting it free from permanganate of soda, in passing over and through the permanganate superheated steam; and (2d) reproducing the permanganate by passing over and through the residue of the first operation a mixture of air with superheated steam; the process was then to be recommenced, and so repeat-

ed indefinitely. We also learned that the French agents had a hydrogen or water-gas process, which consisted in heating in retorts a mixture of hydrate of lime and coal. Now, our poor chemistry led us to the conviction that these processes were not good. In fact, we were so hasty as to conclude that it was so utterly impracticable to reproduce permanganate of soda in the way proposed, that we considered it well-nigh impossible; we were so poorly up in speculative chemistry that we were unable to construct any formulas or theory which could give any show of reasonableness to it. Also, the water-gas process, as a practical project, seemed to us absurd; but we had assisted at the funerals of several water-gas processes, and we might have been prejudiced; we are, of course, ready to think differently about it when the *Journal* exposes our error. But the oxygen process was celebrated in the newspapers, and it was endorsed with enthusiasm by the most eminent of New York chemists. Thus it was till we became an editor. Observing then that the public mind was awake to the importance of oxygen, we were anxious to contribute our little mite in the discussion. But we had established as a principle in our conduct as editor, *nil nisi bonum*, concerning living men and processes, as well as concerning the dead, and our miserable tenacity of opinion left us very little to say; and, besides, who would blame us for not daring to put ourselves in opposition to the most eminent of the New York chemists? One day, however, what seemed to us a very happy thought occurred, and we put it in execution. We sent a letter, as polite as any Frenchman could write, to the Oxygen Company, setting forth that we were in search of news about their process, for publication, and that if consistent with their convenience, interests, &c., they would kindly assist us. To this letter there never came any reply, and we resolved to say nothing until the circumstances should be greatly changed. In the meantime, we ought to say that the hydrogen process was not mentioned in public, and manganate was by degrees substituted for permanganate when the oxygen process was alluded to. The substitution of the manganate, moreover, brought the oxygen process into a certain degree of favor with us, for we were able to comprehend that the residue, on decomposing manganate of soda by superheated steam, could be reconverted into manganate of soda by superheated steam and air. But alas! our constitutional persistence diminished the little favour by suggesting such queries as, What has the superheated steam to do with it? and the old Adam sneered, Ha! ha! somebody has been actually trying the permanganate process and found that it needed improvement! So at last we were very little nearer a realization of the vast practical value of the project than at first.

There were also other things besides our poor chemistry which misled us. Beautiful hydro-oxygen lights, under the name of the new French light, were exhibited at the office of the agents, at chemical lectures, at Ball & Black's store, and much was said about using the new French light at Booth's and other theatres. We saw some of the exhibitions, and testify that they were brilliant; but mischievous persons, in whom, however, we then had confidence, told us that all the oxygen used was made from chlorate of potash, and by a person who had been in the business for a long time. We ought not to have been so imposed upon. If any one has a lingering doubt that what was told us was slanderous, let him enquire at any of the places above named.

Thus we have made a clean breast of the whole matter, and in the most unequivocal manner. There are those who hold that ignorance as well as poverty is a crime: from these we expect no mercy. But we appeal to the Christian men who find the essential quality of actions in the intention. At all events, whatever guilt and punishment be adjudged, there is this consolation, that our case might easily have been worse: If we had presented our false facts and crude chemical theories before being enlightened by the *Journal of Mining*, and thus have come in direct collision with eminent authorities! Especially when (as the *Journal* truly remarks) the SUPPLEMENT is only an appendage.

In conclusion, we reiterate our profound respect and admiration for the *Journal*; in fact, all the foregoing is a tribute to its superiority. If we had the space, and it were appropriate in a scientific periodical of limited scope, we might show how eminent the *Journal* is outside the range of all the sciences; how it excels in suavity, in wit, and in honesty. But there is one of its characteristics, the crowning pride and glory for any station in life, and yet so rare, that we will not forbear to mention it; we allude to its sweetness of temper. Commend us to him of jovial disposition. Every one is a friend to the man of cheerfulness; a laugh is the open sesame to the hardest heart. The *Journal* is a modern Democritus. As a good illustration of this admirable trait, the *Journal* discovers a little blunder of ours when we said that the selling price of oxygen was \$2.50 per hundred cubic feet when we ought to have said \$25. Now, the *Journal* sees only the ridiculous side of this blunder and finds it "matter for laughter," and no doubt had a healthy laugh over it. We envy and praise a disposition which can find mirth in such little things. In future we promise to redouble our scrutiny of the *Journal*, and, if necessary, to provide another copy of it and a new pair of scissors. And we shall strive to be among the first to chronicle the triumph of the new oxygen process over all its detractors.

A New Self-Acting Blowpipe.

DR. W. T. RUSSELL, in the *American Journal of Dental Science* for February, describes a modification of the Russian blast-lamp, by which the blowpipe jet may be directed downwards and sidewise instead of upwards. The alcohol boiler is a strong copper cylinder, closed at top and bottom, three inches high and two and one-half inches in diameter. The vapor-pipe is a tapering tube one-quarter of an inch in diameter at the top, and one-eighth of an inch at the bottom. This pipe passes through the centre of the bottom of the boiler, and terminates just below the upper end of the boiler; the lower end of the pipe is provided with a nozzle or jet piece, having a blowpipe aperture. In the top is a one-eighth inch feed-hole provided with a wooden plug. The instrument is made complete by soldering to the side of the cylinder a stout wire to serve as a handle. To use it, from half an ounce to an ounce of alcohol is poured in at the feed-hole, the plug securely inserted, and the alcohol rapidly boiled over a flame. The jet of vapor is now set on fire and directed upon the object to be heated. It is evident that the character of the blowpipe flame and its direction are under very easy control, and that the instrument is a very great improvement over the ordinary forms of automatic blast-lamps.

An Improvement in the manufacture of Nitroglycerine.

From a paper read before the Franklin Institute of Philadelphia, we compile the following particulars of an improvement in the manufacture of nitroglycerine, recently invented by Stephen Chester and Otto Birstenbinder.

The inventors take, by weight,
Sulphuric acid, 6 parts.
Nitric acid 3 "
Glycerine 1 "

The strength of these is not distinctly stated, but it is understood that the nitric acid and the glycerine are highly concentrated; probably the sulphuric acid may be used at 66°. The average product of the formula is 1.5 parts by weight of nitroglycerine; the maximum yield was 1.8 parts. The peculiarity of the invention consists especially in the method of securing the uniformity of temperature, the exclusion of air, the intimate mingling of glycerine with the acids, and the complete solution of the glycerine.

The mixed and cooled acids are placed in a jar of about the capacity of fifteen pounds of the mixture, the jar resting on a revolving table. In the mixture is suspended a glass tube, having radial arms of various lengths and in different planes, but each terminating in fine orifices. When all is ready, carbonic acid gas is led into the glass tube from a reservoir containing condensed carbonic acid, and at the same time a stream of glycerine, whose flow is regulated by a stop-cock, is also led into the jar. The office of the gas is to keep the contents of the jar well stirred up and cool, and to make a stratum above the liquid to exclude the air. As the effect of the glycerine is to heat the mixture, and of the gas to cool it, a constant low temperature is secured by suitably proportioning their flow. The paper states that "practically it is found that the thermometer may be kept vibrating within two degrees with but little trouble while the oil is rapidly introduced." Also the operator may attend at the same time to several jars, and as these may be of the capacity of sixty pounds of acid, he may mix every forty minutes what will produce at least twenty pounds of nitroglycerine. The working temperature is not plainly indicated, but we suppose it to be that at which the glycerine will readily dissolve or disappear without any destructive reaction.

The paper continues: "After the union of acids and oil is complete, the mixture does not present an oleaginous appearance, and the completeness of the chemical union can only be guessed at by the clearness of the mixture. This should then be mixed with twenty times its bulk of water, in which it apparently unites, forming nearly a clear fluid, without oily appearance. In twelve hours, however, nitroglycerine will precipitate, and as its specific gravity is 1.6, will be found on the bottom of the vessel, and the residue of acids and oil [glycerine?] not previously consumed (if this term may here be used), by the acids, may be poured away with the supernatant water." The nitroglycerine so prepared is now fit for use, and may be kept in a cool place for six or eight days. But if it is to be transported or stored, it must be thoroughly washed with abundance of water.

The paper, although very favorable to the use of nitroglycerine for blasting purposes, yet bears unequivocal testimony to the fact that it is liable to spontaneous and dangerous change. When newly made it bears rough handling, and is with difficulty exploded by per-

cussion; but in course of time it comes into that condition when it cannot be handled with impunity. The paper details experiments made near Stockholm in 1865, to illustrate the safety of using nitroglycerine, and remarks that the nitroglycerine employed was newly made and expressly for the experiments.

Some of our readers will be pleased to learn that they may find the whole of this interesting paper in the *Journal of the Franklin Institute* for February.

The Board of Health and the Gas Nuisance.

IN New York, as in most cities, the illuminating gas is purified from sulphur by causing it to come in contact with dry lime. The lime pretty rapidly becomes charged with sulphur, and its efficiency is gone in a day or two. On opening the lime boxes to replace the exhausted lime with fresh lime, the impure gas gets into the atmosphere, and thus becomes a nuisance to whom the wind brings it. The stench is a little worse than that of the gas as it leaks from the burners, for it comes from gas which is more impure. The people complain, and the Board of Health very properly say to the gas companies that the nuisance must be abated. But they start out with the preamble that the offensive odors are poisonous and deleterious to health, and hereon the gas companies join issue for an argument. Gas companies are, moreover, large bodies, and they move extremely slow from outside influence. Thus it has happened that the debate on the health question is almost interminable, and the nuisance is not abated. A private citizen would scarcely dare to trouble his neighbors as the gas companies do theirs; and if the Board of Health ordered him to abate his nuisance, he would obey willy-nilly. This gas nuisance question has been up since 1866, and still the Metropolitan Gas Company discharges its foul stench into the nostrils of the people. Is it more ridiculous or more shameful that all this should go on, when a few hours' work of a good machinist, and a few hundred dollars' expense for apparatus, would end it? All that is needed is to blow this foul gas into a fire, with simple precautions against explosions, or into an absorbing or oxidizing mixture.

NEW PUBLICATIONS.

A NEW DICTIONARY OF CHEMISTRY.—Adolph Wurtz has associated with himself Bouis, Caverton, De Clermont, Debray, Dehérain, Delafontaine, Friedel, Gautier, Grimaux, Hauteville, Kopp, Louth, Le Blanc, Naquet, salet, Schützenburger, Troost, and Willm for the preparation and publication of a great chemical work, to be entitled "Dictionnaire de Chimie Pure et Appliquée." It is to appear in Paris, and when completed (how soon is not promised) will form two octavo volumes of about 1,500 pages. The first part (pp. xlv.) is now before us, and is a preliminary discourse setting forth the history of chemical theories, beginning with Lavoisier's and extending to the present time. The first paragraph of the history reads thus: "Chemistry is a French science! (La chimie est une science française.) It was organized ('constituée') by Lavoisier, of immortal memory. For ages there was only a collection of obscure receipts, often lying, in use among the searchers after the philosopher's stone, and at a later time among the searchers after the elixir of life. In vain a great man, George Ernest Stahl, had attempted at the beginning of the eighteenth century to give chemistry a scientific basis. His system was not able to resist the test of facts and the powerful criticism of Lavoisier." The history, however, does not show clearly that chemistry is a French science; Sweden, Germany, and England are recognised, and given a pretty high place. The chemical history which should make no mention of Berzelius, Liebig, Davy, and Dalton, would be lean indeed.

The passage we have quoted is, however, the only one which ought not to have been written, and the book is exceedingly interesting and valuable. No one can doubt that M. Wurtz is thoroughly conversant with all the material facts, and whatever he writes is always extraordinarily clear and brilliant in its style. This little book is a very suitable companion to his "Introduction to Chemical Philosophy." Indeed we esteem it so highly that we propose to translate it for publication.

Gelatine, White French.....	per lb	85	to 1 00	Lime, Carbonate, Precipitate.....	per lb	to 28
Cox's.....	per doz	to 2 50		Hypophosphite.....	per lb	to 4 00
Ginger, Jamaica, bleached.....	per lb	to 82		Iodide.....	per lb	to 8 00
Ginseng.....	per lb	to 85		Phosphate, Precipitate.....	per lb	to 40
Glauber Salts.....	per lb	8	to 4	Sulphite.....	per lb	to 81
Glycerine, common.....	per lb	to 85		Lime Juice.....	per gal	to 80
concentrated.....	per lb	to 80		Lint, Taylor's.....	per lb	to 1 80
"Bowers".....	per lb	to 80		Lapis Calaminaris.....	per lb	to 8
"Price's".....	per lb	to 1 15		Laurel Berries.....	per lb	to 12
Glycerole Hypophosphite.....	per lb	to 1 75		Leaves.....	per lb	to 12
Grains D'Ambrette.....	per lb	to 60		Liquid Styra.....	per lb	to 60
Paradise.....	per lb	to 80		Long Pepper.....	per lb	to 90
Gum Acroides.....	per lb	to 24		Lunar Caustic, pure.....	per oz	to 1 30
Amber.....	per lb	to 50		67 per cent., N. S.....	per oz	to 90
Ammoniac.....	per lb	60	to 75	Lycopodium.....	per lb	to 70
Arabic, Turkey, sorts.....	per lb	to 55		Magnesia Carbonate.....	per lb	to 45
1st picked, Trieste.....	per lb	to 95		Calcined.....	per lb	95 to 1 20
2d ".....	per lb	to 75		ponderous.....	per lb	to 1 80
3d ".....	per lb	to 55		Citrate.....	per lb	to 1 75
Barbary.....	per lb	to 40		Sulphite.....	per lb	to 1 20
Asafoetida.....	per lb	to 50		Manganese, powdered.....	per lb	to 8
Benzoin, common.....	per lb	to 90		Saxony.....	per lb	to 12
prime.....	per lb	1 00	to 1 10	Manna, small flake, '67.....	per lb	to 1 85
white marbled.....	per lb	1 10	to 1 15	large flake, '67.....	per lb	to 2 50
Copal, Accra.....	per lb	to 80		sorts, new.....	per lb	to 1 45
Benguela.....	per lb	to 45		Matico Leaves, true.....	per lb	to 50
Kowrie.....	per lb	to 50		Mercury.....	per lb	to 85
Damar, Batavia.....	per lb	to 45		cum Creta.....	per lb	to 54
Singapore.....	per lb	to 45		Magnesia.....	per lb	to 1 25
Elemi, Aromatic.....	per lb	to 45		Cyanuret.....	per lb	to 5 80
Euphorbium.....	per lb	to 25		Sulphuret.....	per lb	to 80
Galbanum.....	per lb	to 95		Mercurial Ointment (1/2 M).....	per lb	to 65
strained.....	per lb	to 1 00		(1/2 M).....	per lb	to 56
Gedda.....	per lb	to 80		Morphia Sulphate.....	per oz	to 14 00
Guaiacum.....	per lb	50	to 65	Acetate.....	per oz	to 14 00
strained.....	per lb	to 70		Muriate.....	per oz	to 14 00
Kino.....	per lb	to 1 10		Valerianate.....	per oz	to 16 00
Mastic.....	per lb	to 4 25		Musk, true.....	per oz	to 16 00
Myrrh, Turkey, powdered.....	per lb	to 75		in grain true.....	per oz	to 83 00
Olibanum.....	per lb	to 80		Nux Vomica.....	per lb	to 18
tears.....	per lb	to 40		Oil, Amber, Crude.....	per lb	to 60
Sandarac.....	per lb	to 65		Almonds (Expressed) Allen's.....	per lb	to 92 1/2
Shellac, Campbell's D. C.....	per lb	to 60		Essential, Allen's.....	per lb	to 23 00
Garnet.....	per lb	to 55		Anise.....	per lb	to 4 25
No. 2.....	per lb	48	to 50	Bergamot.....	per lb	6 00 to 7 00
Native.....	per lb	48	to 50	FF, new crop.....	per lb	to 6 50
Senegal.....	per lb	to 50		Bergamot, Donner's.....	per lb	to 7 00
Tragacanth, common.....	per lb	to 50		Bergamot, —Sanderson's.....	per lb	to 7 00
flake.....	per lb	1 80	to 1 50	Cade.....	per lb	to 1 00
slaky sorts.....	per lb	to 60		Cajuput.....	per lb	to 2 00
Harlem Oil, Dutch.....	per doz	to 50		Camphor.....	per lb	to 1 75
Hoffman's Anodyne.....	per lb	to 48		Caraway.....	per lb	to 2 75
Hydriodate Potash, Atkinson's.....	per lb	to 5 60		Seed.....	per lb	to 5 50
Conrad's.....	per lb	to 5 40		Cassia.....	per lb	to 4 10
Hyoscyami Leaves.....	per lb	to 26		Cinnamon, true.....	per oz	to 1 50
Hypophosphite Ammon.....	per lb	to 4 00		Citronella, prime.....	per lb	to 2 75
Iron.....	per lb	to 8 50		Winter's.....	per lb	to 3 50
Lime.....	per lb	to 4 00		Copalva.....	per lb	to 3 00
Manganese.....	per lb	to 14 00		Croton.....	per lb	to 4 25
Potash.....	per lb	to 4 00		Cubebs.....	per lb	to 4 50
Soda.....	per lb	to 4 00		Cumin.....	per lb	to 10 00
Iceland Moss.....	per lb	10	to 12	Fennel.....	per lb	to 3 00
Indian Hemp, true.....	per lb	to 1 60		Geranium.....	per lb	12 00 to 22 00
Insect Powder, true.....	per lb	to 1 10		Chirita.....	per lb	to 18 00
Iodine, Resublimed.....	per lb	to 6 75		Prepared.....	per lb	to 25 00
Crude, in bulk.....	per lb	to 6 50		Turkish.....	per lb	14 00 to 18 00
Irish Moss.....	per lb	to 10		Jessamine.....	per lb	to 3 50
Iron, Alum.....	per lb	to 1 60		Juniper.....	per lb	to 1 20
by Hydrogen.....	per lb	to 2 80		Berries, true.....	per lb	to 3 50
Carb. Proto.....	per lb	to 45		Lavender, Garden, forte.....	per lb	to 1 65
Precip.....	per lb	to 25		fine.....	per lb	to 1 85
Citrate and Ammonia.....	per lb	to 1 45		Flowers, Chirita, No. 1.....	per lb	to 3 75
Magnesia.....	per lb	to 1 35		Lavender Spike.....	per lb	to 1 00
Quinine.....	per lb	to 10 00		Laurel, Expressed.....	per lb	to 90
Strychnine.....	per lb	10 00	to 12 50	Lemon, Donner's.....	per lb	to 4 50
Hypophosphite.....	per lb	8 40	to 8 50	Lemon, —G. R. & Co's.....	per lb	4 75 to 5 00
Iodide.....	per lb	to 8 25		—Sanderson's (new).....	per lb	to 5 00
Syrup.....	per lb	to 80		Lemongrass, —Winter's.....	per lb	to 7 00
Lactate.....	per lb	to 3 25		Mace, Expressed.....	per lb	to 2 50
Phosphate, Precipitate.....	per lb	to 67		Marjoram.....	per lb	to 1 75
Pyrophosphate.....	per lb	to 1 15		Myrrbane.....	per lb	to 2 00
Syrup.....	per lb	to 65		Neroli Bigarade.....	per oz	to 5 00
Sesquichloride.....	per lb	to 1 45		Chirita.....	per oz	to 5 00
Sol.....	per lb	to 60		Petit Grain.....	per lb	to 28 00
Sesquinitrate.....	per lb	to 44		Olive, pure.....	per gal	to 2 50
Subsulphate.....	per lb	to 1 70		Marselles, quarts.....	per box	to 6 00
Sulphate, pure.....	per lb	to 9		pints.....	per box	to 7 25
Exsiccated.....	per lb	to 17		Orange.....	per lb	to 4 25
Sulphuret.....	per lb	to 81 1/2		Origanum.....	per lb	75 to 1 50
Superphosphate Syrup.....	per lb	to 65		Patchouly.....	per oz	to 4 25
Tannate.....	per lb	to 6 60		Pennyroyal.....	per lb	8 75 to 4 00
India Ink.....	per lb	to 1 75		Peppermint, pure.....	per lb	to 6 00
Isinglass, American.....	per lb	to 1 55		Rhodium.....	per lb	to 10 00
Russian, true.....	per lb	to 6 50		Rose, Kissaulick.....	per oz	to 11 00
Juniper Berries.....	per lb	4 1/2	to 6	Rosemary, French.....	per lb	to 1 75
Juniper Tar Soap, Hazard & Caswell's.....	per doz	to 8 75		Trieste.....	per lb	to 1 15
Kreosote, white.....	per lb	to 1 20		Chirita.....	per lb	to 3 25
Lactucarium.....	per oz	to 75		Sabine, pure.....	per lb	to 3 00
Lead Acetate, pure.....	per lb	to 1 00		Sassafras, cans.....	per lb	to 1 55
Licorice Paste, solid.....	per lb	to 45		Sesame, Salad, fine.....	per lb	to 2 50
Slitly.....	per lb	to 30		Spearmint, Hotchkiss.....	per lb	6 50 to 2 50
Calabria.....	per lb	to 43		Spike.....	per lb	to 80
Imitation.....	per lb	to 87		Succinum, crude.....	per lb	to 70
—rascoo.....	per lb	to 50		re tified.....	per lb	to 70
.....	per lb	to 50		Tanzy, —Eastman's.....	per lb	to 5 00

Oil Thyme, white, pure.....per lb	to 2 75	Seeds, Clover.....per lb	to 16
Valerian.....per lb	to 18 00	Colchicum.....per lb	to 24
Wintergreen.....per lb	to 5 25	Coriander.....per lb	16 to 17
Wintergreen, Van Deusen Bros.....per lb	to 5 25	Cummin.....per lb	to 20
Wormwood.....per lb	7 00 to 7 25	Fennel.....per lb	to 20
Wormseed, Western.....per lb	to 2 75	Fenugreek.....per lb	to 13
Baltimore.....per lb	to 3 50	Hemp.....per bush	to 2 55
Black Pepper.....per lb	to 1 25	Linseed, American clean.....per tierce	to
Cognac.....per oz	to 8 50	rough.....per bush	to 2 50
Ergot.....per oz	to 25	Bombay (gold).....per bush	to 2 50
Opium.....per lb	to 21 00	Calcutta (gold).....per bush	to 2 55
Orange Buds or Apples.....per lb	to 18	Mustard, brown.....per lb	to 16
Curacao Ribs.....per lb	to 28	white.....per lb	to 16
Otto Rose, pure.....per oz	11 00 to	Rape.....per bush	to 5 25
commercial.....per oz	to 7 50	Timothy.....per bush	to 5 00
Peppers, Zanzibar.....per lb	to 83	Worm.....per lb	to 23
Phosphorus.....per lb	to 1 20	Selditz Mixture.....per lb	to 45
Amorphous.....per lb	to 3 25	Senna, Tinnevely.....per lb	28 to 30
Piperin.....per oz	to 1 50	Alexandria.....per lb	45 to
Podophyllin.....per oz	to 80	E. I.....per lb	to 25
Poppy Heads.....per lb	to 25	Smalts, Blue.....per lb	to 23
Potassa, Acetate.....per lb	to 80	Snuff, Lorillard's Maccaboy.....per lb	to 78
Bicarbonate.....per lb	to 42	Coarse Rappee.....per lb	to 1 00
Carbonate.....per lb	to 25	Irish High Toast.....per lb	to 85
Caustic, common.....per lb	to 65	Fresh Scotch.....per lb	to 85
white.....per lb	to 95	Soap, Castile, Mottled.....per lb	17 to 18
Citrate.....per lb	to 1 15	White.....per lb	25 to 27
cum Calce.....per lb	to 15	floating.....per lb	to 25
Hypophosphite.....per lb	to 4 25	Low's Brown Windsor.....per grs	to 15 50
Permanganate, ordinary.....per lb	to 80	Soda Acetate.....per lb	to 80
Phosphate.....per lb	to 2 75	Chlorate.....per lb	to 2 15
Prussiate.....per lb	to 44	Chloride, Liquor.....per gal	to 45
Sulphate.....per lb	to 16	Citrate.....per lb	to 1 00
Tartrate.....per lb	to 1 05	Hydrosulphate.....per lb	to 1 05
Potassium.....per oz	to 3 75	Hypophosphite.....per lb	to 4 10
Bromide.....per lb	to 2 00	Hyposulphite.....per lb	to 10
Cyanide, fus.....per lb	to 82	Nitrate, pure.....per lb	to 22
gran.....per lb	to 1 50	Phosphate.....per lb	to 31
Iodide.....per lb	to 5 25	Pyrophosphate.....per lb	to 1 25
Sulphuret.....per lb	to 35	Sulphite.....per lb	to 32 1/2
Quinine, Citrate, with Iron.....per oz	to 85	Ash.....per lb	to 4
Sulphate, American.....per oz	to 2 50	Sodium.....per lb	to 11 00
French.....per oz	to 2 45	Iodide.....per lb	to 8 00
Quassa, rasped.....per lb	to 7	Spirit Ammonia.....per lb	to 55
Red Chalk Fingers.....per lb	6 1/2 to 7	Aromatic.....per lb	to 60
Red Precipitate.....per lb	to 1 15	Lavender.....per lb	to 55
Resin of J lap, pure.....per lb	to 25 00	Nitre Dule.....per lb	to 45
Rochelle Salt.....per lb	48 to	Rosemary.....per lb	to 60
Roots, Aconite.....per lb	to 24	Sponges, Bahama.....per lb	to 90
Alkanet.....per lb	17 to 18	Bathing, Formes.....per lb	to 4 00
Althca.....per lb	22 to 23	Coarse Brown.....per lb	to 60
Anglica.....per lb	to 35	Fine, medium.....per lb	6 00 to 7 00
Calamus.....per lb	20 to 60	Surgeon's.....per lb	4 00 to 7 00
Colchicum.....per lb	to 20	Zimoca.....per lb	2 00 to 3 00
Colombo.....per lb	to 24	Cup, Turkey.....per lb	20 00 to 30 00
Cutveris.....per lb	to 20	Trieste.....per lb	4 50 to 13 00
Dandelion.....per lb	to 23	Fine Toilet, bleached.....per lb	12 00 to 15 00
Galangal.....per lb	to 12	Fine Trieste, small.....per lb	4 00 to 4 50
Gentian.....per lb	to 11	Glove.....per lb	1 75 to 2 00
Ginger, Race, African.....per lb	to 20	Grass.....per lb	20 to 25
Jamaica, Bleached.....per lb	to 82	Sheep's wool.....per lb	1 40 to 1 50
Golden Seal.....per lb	to 30	Sur Choix.....per lb	to 5 50
Hellebore black.....per lb	to 16	Squills.....per lb	to 12
white, powdered.....per lb	to 65	St. John's Bread.....per lb	to 8
Ipecacuanha.....per lb	to 2 90	Strontia, Marlate.....per lb	to 80
powdered.....per lb	to 3 00	Nitrate.....per lb	to 80
Jalap.....per lb	to 2 25	Oxalate.....per lb	to 1 80
powdered.....per lb	to 2 35	Strychnia, Acetate.....per oz	to 3 75
Licorice.....per lb	to 13	Citrate.....per oz	to 75
Mandrake.....per lb	to 15	Nitrate.....per oz	to 8 75
Orris, Florentine.....per lb	to 16	Pure, crystallized.....per oz	to 8 50
Verona.....per lb	to 14	powdered.....per oz	to 8 25
Pink.....per lb	to 33	Sulphate.....per oz	to 3 75
Rhantany.....per lb	to 50	Valerianate.....per oz	to 5 50
Rhubarb, E. I.....per lb	2 50 to 4 00	Styrax Calamita.....per lb	to 55
Turkey.....per lb	to 24 00	Sugar of Lead.....per lb	to 42
Sarsaparilla, Honduras.....per lb	to 52 1/2	Sugar of Milk.....per lb	to 53
Mexican.....per lb	to 30	Sulphur Sublime.....per lb	6 1/2 to 7
Turbeth.....per lb	to 60	Tamarinds.....per lb	to 10
Valerian, English.....per lb	to 65	Tannin.....per lb	to 8 00
Dutch.....per lb	to 40	Tapoca, East India, white.....per lb	to 16
German.....per lb	to 26	Pearl.....per lb	to 18
Vermont.....per lb	to 40	Tartar Emetic, powdered.....per lb	to 95
Snake, Virginia.....per lb	to 15	crystallized.....per lb	to 1 15
Seneca.....per lb	75 to	Tin Foll, thin.....per lb	to 45
Rose Leaves.....per lb	to 2 50	French, No. 15.....per lb	to 70
Rosemary Leaves.....per lb	to 12	Tobacco.....per lb	to 40
Rubigo Ferri.....per lb	to 10	Tonqua Beans, Para.....per lb	to 75
Saffron, American, new.....per lb	to 2 25	Angustora.....per lb	to 95
Spanish, true.....per lb	to 17 00	Uva Ursi, American.....per lb	to 12
Sago, Pearl.....per lb	to 12	French.....per lb	to 13
Salicin.....per oz	to 60	Vanilla Beans, Bourbon.....per lb	to 11 00
Sal Acetosella.....per lb	to 55	Mexican.....per lb	to 15 00
Ammoniac.....per lb	to 16	Venice Turpentine.....per lb	to 80
Soda, Newcastle.....per lb	to 6	Veratria.....per oz	to 5 25
Santonine.....per oz	to 1 80	Vitriol, Blue.....per lb	10 1/2 to 11
Sassafras Bark.....per lb	to 15	Green.....per lb	to 2
Scammony, virg., true.....per lb	to 20 00	White.....per lb	to 9
Seeds, Anise.....per lb	to 23	Wax, White,—J. I. Elkens.....per lb	to 75
star.....per lb	to 55	No. 2.....per lb	to 72
Canary, Dutch.....per bush	to 5 25	Phillips'.....per lb	to 90
Smyrna.....per bush	to 5 25	Yellow.....per lb	to 52
Cardamom, Malabar.....per lb	to 5 00	White Wax,—Leonhardt's.....per lb	to 90
Carul.....per lb	to 22	Ockmid.....per lb	to 90
Celery.....per lb	to 75	Sun-bleached.....per lb	to 75

White Precipitate.....	per lb	to 1 55
White Pepper.....	per lb	to 55
Wine, Colchicum Seeds.....	per lb	to 1 40
Wood Naphtha.....	per lb	to 95
Wormwood Herb.....	per lb	to 25
Yellow Bark.....	per lb	to 30
Dock.....	per lb	to 25
Zaffre.....	per lb	to 1 15
Zinc, Acetate.....	per lb	to 1 25
Chloride.....	per lb	to 1 80

DYES AND DYE STUFFS.

Aniline Blue.....	per lb	to 8 00
Red.....	per lb	to 7 50
Violet.....	per lb	to 8 00
Annatto.....	per lb	1 00 to 1 75
Cochineal, Honduras.....	per lb	1 40 to 1 40
Mexican.....	per lb	1 30 to 1 40
Cudbear.....	per lb	23 to 45
Cutch, Pegue.....	per lb	to 18
Gambier.....	per lb	to 8
Indigo, Bengal, fine.....	per lb	to 3 25
good.....	per lb	2 50 to 2 75
middling.....	per lb	2 00 to 2 10
Madras, fine.....	per lb	1 60 to 1 65
ordinary.....	per lb	1 00 to 1 25
Korrah.....	per lb	to 2
Guatemala.....	per lb	2 00 to 2 10
Caracas.....	per lb	to 1 65
Lac Dye, good to fine.....	per lb	55 to 60
Logwood, Campeachy.....	per lb	to 2 1/2
Honduras.....	per lb	to 2 1/2
Jamaica.....	per lb	to 2 1/2
Lauguna.....	per lb	to 2 1/2
St. Domingo.....	per lb	to 2
Extract.....	per lb	13 to 16 1/2
" in bulk.....	per lb	to 13
Lima Wood (gold).....	per bbl	70 00 to 71 00
Madder, Dutch.....	per lb	22 to 24
French.....	per lb	23 to 25
Nutgalls, Blue, Aleppo.....	per lb	40 to 42
Orehite.....	per lb	30 to 35
Persian Berries.....	per lb	50 to 55
Safflower.....	per lb	60 to 65
Sapanwood.....	per lb	12 to 15
Turmeric.....	per lb	15 to 16
Ultramarine.....	per lb	23 to 45
Wood.....	per lb	15 to 16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials.....	50	percentage discount.
German Flint Bottles and vials.....	30	" "
Flint Bottles and vials.....	25	" "
Furniture Ware.....	10	" "
Perfumer's Ware.....	25	" "
Chemical Ware.....	net	" "
Syringes.....	10	" "
Homoeopathic vials.....	10	" "

NAVAL STORES.

Pitch, City.....	per bbl	to 4 00
Resin, Extra Pale.....	per 250 lbs	8 00 to 8 00
Pale.....	"	7 00 to 7 00
No. 1.....	"	5 00 to 5 00
No. 2.....	"	4 00 to 4 00
Strained.....	"	4 00 to 4 00
Common.....	"	to 3 75
Spirits, Turpentine (North Carolina).....	per gal	55 to 55
Turpentine, Soft.....	per 250 lbs	to 8 00

OILS.

Linseed Oil, American.....	per gal	to 1 15
English.....	per gal	to 1 15
Palm Oil.....	per lb	to 16
Paraffine Lubricating Oil.....	per gal	to 40
Sperm, Crude.....	per gal	to 2 20
Sperm, Winter, unbleached.....	per gal	to 2 30
Lard Oil Prime, City.....	per gal	to 1 80
Red Oil, City distilled.....	per gal	to 70
Red Oil, Saponified.....	per gal	to 78
Whale, Crude.....	per gal	to 1 35
Whale, Bleached, Winter.....	per gal	to 1 40

PAINTS (DRY).

Asphaltum, opt.....	per lb	to 7
Barytes, Foreign.....	per ton	to 45 00
Barytes, American.....	per lb	to 2
Black Lead.....	per lb	8 to 12
Black Ivory, drop, fair.....	per lb	10 to 13
good.....	per lb	18 to 20
best.....	per lb	24 to 28
Blue Celestial good.....	per lb	to 14
Chinese.....	per lb	to 1 00
Prussian, fair to best.....	per lb	85 to 1 00
Ultramarine, fair to best.....	per lb	23 to 45
Chalk, Lump.....	per lb	to 2 1/2
China Clay.....	per lb	to 2 1/2
Chalk.....	per bbl	to 4 50
Green Paris, fair to best.....	per lb	85 to 50
Green Chrome, fair to best.....	per lb	33 to 42
Lamp Black—Coach Painter's—L. Martin & Co.'s.....	per lb	23 to 25

Lamp Black, ordinary.....	per paper	8 to 12
Litharge, powdered, American & English.....	per lb	11 to 11 1/2
Ochre, Yellow, French, dry.....	per lb	2 1/2 to 4
Red Venetian.....	per lb	3 1/2 to 5
Red Indian, fair to best.....	per lb	11 to 18
Red Lead, American.....	per lb	11 to 12
English.....	per lb	14 to 15
Rose Pink.....	per lb	to 20
Sienna, American.....	per lb	7 to 9
Italian, B'nt.....	per lb	18 to 23
Raw.....	per lb	15 to 20
Umber, Crude, Turkey.....	per lb	5 to 7
burnt.....	per lb	8 to 9
Tieman's Calif. Vermilion.....	per lb	to 1 10
Pure Carmine.....	per lb	to 16 00
Soluble Blue.....	per lb	to 1 25
Vermilion, English, pale.....	per lb	to 1 25
deep.....	per lb	to 1 20
American.....	per lb	to 85
Chinese.....	per lb	to 1 30
Trieste.....	per lb	to 1 20
White, China.....	per lb	to 22
Cremnitz.....	per lb	to 30
Lead, pure.....	per lb	13 to 14
good.....	per lb	9 to 11 1/2
Paris.....	per lb	3 1/2 to 4
Zinc, American.....	per lb	10 to 12 1/2
Zinc, French.....	per lb	14 to 16
Whiting.....	per lb	8 1/2

PAINTS (IN OIL).

Black coach.....	per lb	28 to 30
Blue, Chinese.....	per lb	90 to 1 00
Prussian, fair to best.....	per lb	85 to 80
Brown, Van Dyke, fair to best.....	per lb	20 to 28
Dryer, Patent, American.....	per lb	12 1/2 to 14
English.....	per lb	12 1/2 to 15
Green, Chrome.....	per lb	18 to 27
Imperial.....	per lb	15 to 13
Paris.....	per lb	33 to 42
Verdigris.....	per lb	25 to 63
Putty, in bladders.....	per lb	5 1/2 to 6
in bulk.....	per lb	to 5 1/2
Red Venetian, fair to best.....	per lb	8 to 16
Sienna, burnt, fair to best.....	per lb	22 to 35
White Lead, English, B. B.....	per lb	to 16
American, pure.....	per lb	18 1/2 to 14
good.....	per lb	11 to 12 1/2
fair.....	per lb	9 to 10
White Zinc, American.....	per lb	10 to 13
French.....	per lb	15 to 15 1/2
Yellow Ochre.....	per lb	9 to 10
Chrome, fair to best.....	per lb	16 to 32

SPICES.

Cassia, in mats.....	per lb	to 29
Cloves.....	per lb	to 48
Ginger, Race, African.....	per lb	to 19
Mace.....	per lb	to 1 55
Nutmegs, No. 1.....	per lb	to 1 45
Pepper.....	per lb	to 38
Pimento, Jamaica.....	per lb	to 34

WINDOW GLASS.

American Window—1st, 2d, 3d and 4th qualities.

6 by 8 to 8 by 10.....	Per fifty feet	\$ 6 25 to 3 75
8 by 11 to 10 by 15.....	"	6 75 to 4 75
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 16 to 16 by 24.....	"	8 50 to 6 00
18 by 22 to 18 by 30.....	"	10 00 to 7 00
20 by 30 to 24 by 30.....	"	12 50 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 40.....	"	16 00 to 10 00
28 by 40 to 30 by 48.....	"	18 00 to 14 00
34 by 54 to 32 by 56.....	"	20 50 to 16 00
32 by 58 to 34 by 60.....	"	24 00 to 18 00
34 by 62 to 40 by 60.....	"	26 00 to 21 00

The above is subject to a discount of 25 per cent.

French Window—1st, 2d, 3d and 4th qualities. (Single thick.)

6 by 8 to 8 by 10.....	Per fifty feet	\$ 6 25 to 4 75
18 by 11 to 10 by 15.....	"	6 75 to 5 00
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 18 to 16 by 24.....	"	8 50 to 6 00
28 by 22 to 18 by 30.....	"	20 00 to 7 00
20 by 30 to 24 by 30.....	"	12 00 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 48.....	"	16 00 to 10 00
28 by 40 to 30 by 48 (3 qts).....	"	18 00 to 14 00
34 by 54 to 32 by 56 (3 qts).....	"	20 50 to 16 00
32 by 58 to 34 by 60 (3 qts).....	"	24 00 to 18 00
4 by 52 to 40 by 60 (3 qts).....	"	26 00 to 21 00

Subject to a discount of 20 per cent. English sells at 10 per cent. discount off the above rates.

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SCIENCE AND VIOLENCE.

HISTORIANS tell us that there is a vein of thought running through even the empires of the battle-axe. We think the vein in many cases thin, and especially in ancient times when the elementary instinct of power governed more fully than in later days. The motives of men become more complicated as their affairs become more numerous, and nations contain as many reasons for action as they contain families. In old times men were not ashamed to confess their simple love of greatness and, in default of that quality, their love of admiration. They liked to be carried about like some Queen of the May, or with elephants to increase their apparent size, and numbers to atone for their actual littleness. We must not despise these promptings of nature—these undefined strivings after the beautiful and the good. According to an old northern saying of our people, "it came up the back to do so," explaining an unknown impulse by a vague feeling that the whole column of the body was filled with a power that took its own direction.

When victory produces self-satisfaction and leisure, there is an attempt to think more clearly, and we have every nation giving out with more or less fulness its own theory of itself and its relations to the universe. They seek wisdom for a little and encourage learning, but always with the rod in hand, always letting you understand that above all stands power. Their rights are those of the New Zealanders—"I ate the former possessor."

Still this love of wisdom has taken a very brilliant form at some courts, and in part the love has been sincere. The old laws of Manu enjoined it, and gave orders to the king to learn "from those who knew the three Vedas the triple doctrine comprised in them together with the primeval science of criminal justice and sound policy, the systems of logic and metaphysics and sublime theological truth; from the people he must learn the theory of agriculture, commerce, and other practical arts." Here is seen the love of wisdom and goodness which has burnt in the East at various times and places more violently than we can now imagine, so that at some periods it seemed certain to take the lead in all governments. Kings and courts were dazzled by knowledge, and wise men were invited and honoured, whilst systems of abstract thought grew up in such variety that it is hard to find one in Europe which has not existed previously in the East. So familiar, indeed, had they become that many sank down by a natural decay to less serious thinkers, and after various transformations, when their masters died, fell exhausted in some ignoble *reductio ad absurdum*. That this is true we may illustrate by the account of the ostler stealing his master's horse and caricaturing the idealists by saying that there was no horse, it was only an idea. The master returns the same answer after he gives him a flogging; saying that, in reality, he had received no flogging; exactly as Johnson and Boswell laughed at Berkeley instead of the far-distant Fartosh. It is melancholy to see great thoughts coming down in the world like decayed families, as a Greek emperor might have seen, had he looked forward, his descendants intended for a throne, dying unknown and lonely on the extremity of our distant island. We tremble for our race

when we think of the East and look on men who loved truth so devotedly dying apparently by millions, rubbed off the floor of life by the sweeping hand of the selfish love of power. These scenes were in struggles for magnificence, in which sunshine and glitter had the victory. That is a wonderful place where the sun shines; and the greatest pun perhaps ever made was the saying "Light comes from the East,"—for after all it is a pun.

Passing over times and places, we find that to invite wise men to courts became such an admired taste that King Arthur, we are told, had two hundred philosophers at his court. Nothing shows the bent of men more than the statements of romance: there men do exactly as they please. We had certainly an inclination to run through the ages, and examine the relations of men of science and learning to power. It is a good habit, we think, the comparison of times; and we do not care to be laughed out of it by the story of the German writer on police, who began his history, whether real or mythical, in the words "Adam was the first policeman." We have seen with our own eyes a claim made for this name as the first freemason, a no less wonderful piece of literature. We move more freed from present human prejudices in ancient times; as soon as we arrive at the breakage of the Roman Empire, or perhaps rather at those ages where the busy roots of modern life grew in darkness, men became as cautious of speech as if they were at the back of their friends. In old times there began a simpler relationship between the men who had original thought and those who had power. But the two powers did not coalesce well, and one thinks with shame even now of Plato attracted, shuffled off, and re-attracted to one Dionysius after another, only to be repelled at last. In earlier times one feels sorry for poor Croesus seeking the sympathy of the wise, and one learns by such things that they knew their position as well as any can know it now, although they have been obliged to move to the side as the sword came in their way. Indeed, we feel that it must have been a great country that felt, even in the advanced social period, that Diogenes was a power. A small people would have despised him, and it would require the most choice of our time to treat such a one with attention such as he met.

In reality, however, we have not much to do with such men; they were not the intellectual ancestors of chemists, although, being somewhat related, since men who thought on matter and mind were not more allied in old time than with us, we think it interesting to see how, as a race, they were treated by the men of action of the time. Whenever these desired to fight for their interests, they cleared the ground of all such impediments as learning produced, just as they would have removed beggars and strolling minstrels. Perhaps scientific men are rather the descendants of astrologers and magicians that graced the courts of the East, and who at times seemed to have real power, and at other times were superior slaves. The time of action came, and they were scattered like mummers. The scientists may spring from the physicians of Egypt, who advanced so far in their division of labour that it was considered that one part of the body was enough for the study of one man. They must have risen high when one who was sent to the Persian court was so incensed by the removal from his wife and family that he found means to cause an invasion of Egypt, according to a report. But although we may view them as we do, cultivating chemical knowledge with some success on the Nile, we

see them also as unhappy instances of the fact that the man of mere action has had his way, and the nation has long suffered the deepest degradation.

Ever will the man of mere action put aside the best, that his little purpose may flourish. We have heard of an engineer who proposed in this, our own island, to drive a railway through a park which had been the property of the citizens longer than history could tell, so as to save a slight curve, such as he often made apparently for his amusement. We have heard of another who proposed to carry a similar road through an ancient church, in which the bodies of kings and queens had lain for centuries, and had fascination to delude others into the crime, and now the spot is made the stable of screeching and unfeeling locomotives. It is always the same with the man of mere action; we have seen him in various conditions, but he is always one. He has cheated us at marbles, where his principles were fully developed as a chicken's are from the shell; we have seen him grown into manhood, and he has bullied and browbeaten us, and we have seen him old, when he has wheedled and made use of us. His demands are for himself. We have known him wandering over Europe for inventions, for which he obtains a patent, careless of the fact that another is the inventor, and when this has failed we have seen him trying to prove that no man has a right to keep his own discoveries to himself, hoping by this means that the sharpest eye and longest purse will seize and keep them. He has even obtained the apparent consent for the time of some most eminent men, having deceived the very elect of the nation. He wishes to seize the golden egg as soon as it is laid, but he cares little for the life of the hen. That egg will last his day. Everywhere he is the same; he will open the world with his sword; it is to him a mere oyster or food supply, and it matters nothing to him if he sacrifices the life of a saint or a fly. Shakespeare saw one undisguised on a heath near Forres, when describing himself in these words: "and like a rat without a tail, I'll do, I'll do, I'll do." This expresses activity without thinking.

There is, however, the man of action in the highest sense inspired by thoughts and working them out. Him it is probable no man can equal; such have become the most admired of mankind, but as every one has his hero we shall make no allusion, as it is not of consequence to stir up opposition on a point little to be regarded here.

The man of mere action, whose principles are self, differs so much from the man of action governed by love of his race, that in narrowness one can only compare him with the bridge of Sarat which, if he ever cross, it will be because he surpasses it in narrowness. To us he seems better named the man of violence. He has never learnt principles, and to a man who cares not for these we need not speak of science; its volumes turn into receipt books.

It has been said that the government of this country does too little for scientific men. The work of science, like other departments of thought and action, has been left to be developed by the genius of the country. Looking at the history of scientific ideas, it seems to us that our nation has not much to fear in comparison with others. We shall even go farther, and say that for breadth of views no nation can go beyond us. We are even still more prejudiced, and are inclined to think that, taking the larger and wider theories into consideration, we have done more than our share. The national force has been great, and that in-

stinct which has produced so many poets of the highest class has also produced bold thinkers leaping our fields of thought with seven-leagued boots, whilst the workers on the fields have been too few for full cultivation. We are not quite prepared to prove all this, but we have long thought it, and it is not a matter on which to produce rapid conviction to an opponent. But, from whatever cause, we consider ourselves lagging: our powers are not made the most of; we consider that in this country the number of purely scientific men is too small. We think, too, that the powers of the whole are not fully brought into action. There is also a want of care to produce a supply, and, when produced, to give them position. The country must suffer by this in every department where science is of value.

The first result of this belief, which is held by all men who think on the subject, is to blame the government. We, too, have had an inclination to do so, and there we must seek help; but as a question of morals, who is to blame? If we search the factories of this country, do we find that the manufacturers have been before the government, and that they have made such use of scientific men and scientific knowledge as to enable them to stand guiltless? Our belief is against this. We stand guilty as a nation of an attempt to ride over principles of science and to obtain results by the violence of our activities.

There have been many wise men who have devoted great sums to the nation, that those after them might be taught without cost, but ever these witches from Shakespeare have come and have wrested the power from their hands, turning it to baser ends. The man of selfishness and mere action has been, as usual, at the money boxes; and he has done more: he has lived on the brains of whole cities and countries. He has darkened whole generations for whom his father had provided light; and it is not much to say that for every day's food a family has been ruined. Cannibals are more easily taught, and less likely to return to their feasts. In early times we have seen them in the governments; in modern times they are more difficult to find: they hunt after charities provided for the poor and ignorant, or take hold of others' shares that make them rich as princes.

We desire protection from these men of violence. We look on the keen minds of our ancestors, and say to ourselves: "If such men as these had found peace and fair-play, what a world we should now have." We read the words of Roger Bacon, written 600 years ago, and most interesting to chemists:—"The elements are made out of *yle*, and every element is converted into the nature of another element, and everything into everything; for barley is a potential horse—that is, by its occult nature, and wheat is potentially man, and man is potentially wheat." When men begin to put the problems of nature so sharply before them, they enquire. Let us suppose *yle* to be the substance of the metaphysicians, and we have an opinion little differing from one lately put forward to account for elements, although disagreeing as to the transmutation—a point that most chemists will very willingly concede in theory. Well, this style of enquiry was suppressed by authority, and it is for others better acquainted with our old universities to say if up to this century a more advanced knowledge of matter was received by those who studied at Oxford. Six hundred years have been given for the study, and we think we have met many behind Bacon. He certainly thought Oxford a proper

place for such studies. Let us imagine the world, if he had been encouraged to make a school; but one step may destroy a life, and that solemn truth stands before us every day. We seek protection from governments, although they in old time have destroyed so much that thoughtful men built; but the men of violence have changed their beat, they are not in authority, they find more to be gained by lurking in secret.

It is not for single individuals to protect themselves—they stand as nothing before their fellow-men, on rare occasions excepted, when they become representative; it is not even possible for a community to protect itself—it lives, but its organization does not continue permanent except in its government. It is only the immortal that can protect us through generations; and in the State we have the nearest approach to that continuance which savours of immortality. It is for this reason, then, that we must look to governments, not as men unable to help themselves, but as men who, having less than a century to live, implore for the young the aid of that whose life will remain to long futures.

There has been in England a pride of individual life which has brightened its annals in a manner peculiarly glistening, but has greatly prevented the concentration of its power in many directions. Its too practical eye has never seen the abstract living government moving on through all generations, muttering its thoughts through changeable men, and has failed too much to know that this could act as a lens whereby the people's power could be intensified. As men, we are not narrow, and there is an elasticity in our institutions which allows of great width; but from whatever cause, our universities have been lacking in breadth, and they have taught our statesmen. Out of the earth, deep among the roots, has grown the sap of new institutions, and the nation must drive on the learned men who were appointed to lead it. It is a misfortune, and because of this it seems needful that universities shall no longer be few in number, so that all the country should be shaped in one groove, but sufficiently numerous to present oppositions to any body of men who will too exclusively pursue one idea. The existence of such will be a safeguard to the nation, who will be able to have a choice of education for their sons, whilst the control of government will prevent them sinking into those private depths of selfishness which have drowned so many endowments. If education is not under a great public control the funds will be again wrested from their proper ends. The government only can protect the land from "the violence of men that dwell therein."

ON THE SULPHATES OF OXIDE OF ANTIMONY.

BY. W. P. DEXTER.

(Concluded from American Repr., March, 1869, page 130.)

Basic Salts.—The basic sulphates of antimony form a series of salts in which the oxide is combined with two, one, and half an equivalent of acid. Besides these, there appear to be others, only one of which I have examined, and which are probably combinations of these simpler salts. They occur under various and often unexpected conditions; but, in general, the degree of dilution of the acid seemed to have the greatest influence in their production. When oxide of antimony is boiled with sulphuric acid diluted with about its volume of

water, a turbid liquid is obtained in which, under the microscope, no distinctly crystalline body can be perceived. On continuing the ebullition, when the acid has reached a certain degree of concentration, the liquid, provided more oxide be present than it can dissolve, becomes suddenly clear from the subsidence of a heavy sand-like body. If the boiling have been stopped as soon as this takes place, the substance will be found under the microscope to consist of flat rhombic prisms of considerable size. By continuing the boiling but for a few seconds these disappear, without any change of appearance perceptible to the eye; but by the microscope the prisms are seen to be replaced by octahedral crystals. Generally, however, the prisms are from the first mingled with the octahedral salt, from which it is very difficult in this way to obtain them quite free. By a slight concentration of the acid, as has been said, the octahedra are left perfectly free from the prisms.

These octahedra appear to belong to the regular system, are frequently more or less distorted, but very seldom show any replacement or modification of the crystalline form. The faces are striated, and to these little projecting angles, acting like prisms, is due, it seems to me, the slight amount of colour which they exhibit in polarised light. As the liquid in which they have formed cools, crystals resembling those of the neutral sulphate generally separate. To prevent admixture with these, the porous plate upon which they were collected was covered and imbedded in hot sand. In their analysis were obtained—

1. From 1.1663 salt, 0.863 Sb₂O₃, and 1.1815 BaOSO₃.
2. From 1.1359 of another preparation, 0.847 Sb₂O₃, and 1.1724 BaOSO₃.

	Calculated.	I.	II.
SbO ₃	64.65	63.57	63.91
2SO ₃	35.35	34.79	35.44
	100.00	98.36	99.35

The salt is the bisulphate, and its formula SbO₃2SO₃.

Mr. Péligot, by the action of fuming sulphuric acid upon oxide of antimony, obtained a salt "in the form of small, brilliant crystals," of which he has given the analyses—

SbO ₃	63.0	64.3
SO ₃	37.1	35.0

and which therefore seem to have been the salt just described. In fact, hydrated sulphuric acid, gently warmed, unites with the oxide to form this compound which is then dissolved at a higher temperature, with production of the neutral salt.

In the formation of both the octahedral and prismatic crystals, there appears to be direct conversion of the undissolved oxide into the salts: they are also deposited from a solution of the oxide in sulphuric acid of the proper concentration. There is, however, a peculiarity attending their formation. When they have separated from the acid liquor, they can be decomposed by addition of water, and again reproduced by concentrating the liquid. But if by still further evaporation they have been redissolved in the acid as neutral salt, or if the oxide be at first dissolved in concentrated acid, and the solution in either case decomposed by water, on evaporation the octahedral crystals will not be obtained, or will be obtained only in small quantity; the separated basic salt re-dissolves at last completely in the acid. By arresting the evaporation at the proper period, as has been said, octahedral crystals may be deposited from the liquid on cooling, but no conversion

of the basic salt into them seems to take place. By decomposing the basic salt with carbonate of soda, and treating the resulting oxide with dilute acid, the octahedral crystals can be again produced.

Finding it difficult to obtain the salt mentioned as occurring in flat prisms free from the octahedral crystals by concentration of the acid liquid in an open vessel, experiments were made with acid of various degrees of dilution. An acid of sp. gr. greater than 1.6 gave by boiling with the oxide octahedral crystals; at 1.597 the prisms first appeared; at sp. gr. 1.57 the oxide was converted into prisms free from the other salt, but smaller than those produced by the gradual concentration of the liquid; and at 1.554 the product consisted only of needles. So that the production of the body in question is confined within narrow limits of concentration of the acid. The salt was dried, like the bisulphate, upon a plate surrounded with hot sand.

Of two different preparations,

0.624 salt gave 0.4864 Sb_2S_3 and 0.571 BaOSO_3 : (I).
0.524 " " 0.4097 Sb_2S_3 and 0.479 BaOSO_3 : (II).

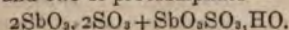
Whence their composition was

I.				II.			
eqvts.				eqvts.			
SbO_3	66.97	3.00		67.17	3.00		
SO_3	31.42	5.16		31.39	5.13		
HO (loss)	1.61	1.17		1.44	1.05		
	100.00			100.00			

and their formula $\text{SbO}_3, 5\text{SO}_3, \text{HO}$, which requires

SbO_3	67.75
SO_3	30.86
HO.....	1.39
	100.00

The salt is most probably a compound of two atoms of bisulphate and one of protosulphate—



This composition explains the facility with which it is changed by prolonged boiling and concentration of the liquid into the bisulphate; it being only necessary that the equivalent of water be replaced by one of acid.

The crystals of this salt appear large and well defined under the microscope with medium powers. They are four-sided prisms, having for their section a rhomb with very unequal angles, and terminated by two or four faces, which, from the flatness of the prisms, are not distinctly visible: they belong apparently to the right rhombic system. Formed by the gradual concentration of the acid, they have always the same form; but by exposure of the liquid, or of a solution of the oxide in dilute acid, to the air, crystals are obtained of the same general appearance, which seem to be of the oblique rhombic system.

By exposure for several weeks to the air of the liquid from which the prisms had separated, a fine white powder was deposited, consisting of minute irregular needles, in which, with a power of about 600, no further shape could be made out. The quantity was only sufficient for one analysis, and a subsequent attempt to form them did not succeed. 0.3447 gave 0.2668 Sb_2S_3 , and 0.2167 SO_3 .

	Calculated.	Found.
SbO_3	74.92	73.89
SO_3	20.48	21.59
HO.....	4.60	(4.43)
	100.00	100.00

The same salt, without the atom of water, was made by Brandes by the action of alcohol upon the neutral salt. I have obtained in this way a salt in small needles, but which was not analysed.

The last of these basic salts, the combination of two atoms of oxide with one of acid, has been described and analysed, both by Brandes and by Péligré. It is produced by the decomposition by water of the neutral salt, or its solution in dilute sulphuric acid. Precipitated from a solution, I have found it amorphous, but by standing two or three days in contact with the liquid, it crystallises in needles. According to Brandes, the amorphous salt loses the greater part of its acid by washing with water. The neutral salt, or rather the magma to which the solution of oxide of antimony in concentrated acid congeals on cooling, is resolved into minute crystalline needles, when decomposed by warm water, or when by the dilution of the acid sufficient heat is evolved. They subsided readily in the liquid, and could be boiled with repeated portions of water without changing their appearance, or the production of an amorphous substance. When brought upon a filter and washed copiously with boiling water, the filtrate contained constantly a little sulphuric acid, and deposited oxide of antimony on cooling. From the agreement of the result of their analysis with the calculated composition, it would seem that in the crystalline state this salt is not decomposed, or is but slowly decomposed by hot water. 0.8334 of the salt prepared in this way, and dried by pressure in paper, gave 0.8393 Sb_2S_3 and 0.2735 BaOSO_3 .

	Calculated.	Found.
2 SbO_3	85.66	86.52
SO_3	11.71	11.27
HO.....	2.63	(2.21)
	100.00	100.00

Brandes found in the salt 3 per cent of water. Péligré obtained it water free, and also with two atoms of water. Heated to 100° it lost one-half per cent; the rest of the water required for its expulsion a temperature above 240°.

The series of the sulphates of antimony resembles those of the earths glucina and zirconia, considered as sesquioxides. The neutral sulphate of neither of these earths combines with hydrate of sulphuric acid to form an acid sulphate,* and the most basic compound of both contains two equivalents of base to one of acid. In place of a bisulphate, they have salts with three atoms of acid to two of the earths, and no intermediate salt, like that of antimony, has yet been discovered. From bismuth the antimony series differs in that the salts of the former metal are decomposed by water, according to Heinz and Ruge, into basic salts containing equal equivalents of acid and base; here, also, no intermediate salt is yet known. A more important difference lies in the fact that oxide of bismuth appears to form one, if not two, acid sulphates. I have analyses indicating the existence of compounds of the neutral salt with three atoms of hydrate of sulphuric acid; and also of a salt crystallising in beautiful pearly scales, and containing equal equivalents of the neutral sulphates of bismuth and potash. A salt with three equivalents of sulphate of potash has been described by Heinz. The further account of these bodies must be reserved until their analyses have given more trustworthy results.—*American Journal of Science*, 1868.

* Zirconia, Berzelius, but perhaps not quite certain; glucina, Berzelius, and my own experiments.

THE SALT DEPOSITS AT STASSFURT.

BY MESSRS. BALD AND MACTEAR.*

THE southern part of the North German Basin is divided by the Hartz into two portions, which are known as the Thuringian and the Magdeburg Halberstadter basins, in which salt has been raised for a lengthened period in the form of brine.

The basin covers a surface of 120 English square miles, and is filled with new red sandstone, which is not broken up by any of the older formations. It is interspersed by elevations of gypsum, which is considered a certain indication of the presence of common salt. In the Prussian mine at Stassfurt, in the Magdeburg basin, after passing through 27 feet of alluvial soil, a thickness of 576 of new red sandstone is at once reached, then 213 feet of gypsum, anhydrite, and marl, the salt being found at a depth of 816 feet. In the Anhalt mine (half a mile from the Prussian one) the sandstone is entirely wanting, the salt bed being reached at a depth of 480 feet, after passing through 20 feet of soil and 460 feet of gypsum, anhydrite, and marl. The boreholes at Schonebeck (some miles from Stassfurt) show very distinctly the various strata with which the basin is filled up as the salts gradually get deeper and deeper. Thus, at bore No. 8, the salt is 1000 feet from the surface, the intervening strata being 200 feet of alluvial soil and 800 feet of new red sandstone. At No. 5 there is 37 feet of alluvial soil, 166 feet of mussel-chalk, and 1,277 feet of new red sandstone, the salt being 1,480 feet from the surface. At No. 6 there is 30 feet alluvial soil, 877 feet mussel-chalk, and 473 feet new red sandstone, the salt being 1,380 feet from the surface. At No. 4 there is 25 feet alluvial soil, 211 feet of what in Germany is called keuper and lettenkohle (literally, copper and letten coal). This keuper is the equivalent of the saliferous and gypseous shales and sandstones of Cheshire, a member of the "Irias" or new red sandstone formation. Lettenkohle is a variety of lignite known in the district as brown coal. Next we have 1,067 feet of mussel-chalk, 377 feet of new red sandstone, and the salt at a depth of 1,680 feet. Bore No. 3 is somewhat similar to No. 4, there being 30 feet alluvial soil, 435 feet keuper and lettenkohle, 1,087 mussel-chalk, 212 new red sandstone, the salt being 1,764 feet from the surface.

In the Magdeburg basin the salt rests on new red sandstone, and in the Thuringian basin on mussel-chalk and magnesian limestone.

It is only at Stassfurt and Erfurt that the salt is mined; at all the other places it is obtained by means of brine wells, the liquor from which is concentrated by the graduation process, which consists in allowing the weak liquor to trickle through walls made of bundles of thorns and brushwood.

The graduation houses consist of a timber framing, into which the faggots or thorns are built in regular walls. The structure is covered with a roof to protect it from the rain, but the sides, of course, are open to admit of the free passage of air, which, together with the solar heat, forms the evaporating medium.

The walls are from 30 to 50 feet high, and of immense length, the celebrated one at Schonebeck being fully more than an English mile in length. They are placed in the manner best suited to obtain the full benefit of the prevailing wind. The house is divided into several sections, and the weak liquor is pumped up into a cis-

tern, from which it is led by means of a perforated pipe along the top of the first division, down the sides of which it trickles into a large wooden tank underneath. From this it is pumped up and allowed to trickle through the second division, from underneath which it is pumped on to the third, and so on until it reaches the last one. In graduation houses, where the number of compartments does not exceed three, and, indeed, in all of them, to a greater or less extent, the liquor is pumped through the same division several times. The weak brine at Schonebeck contains $7\frac{1}{2}$ per cent of common salt, which, at the finish of the graduation process, is raised to about 22 per cent. In this state it is run into large tanks, of which there are eight at Schonebeck, of an aggregate capacity of about two and a half million gallons. From these tanks it is drawn off to the evaporating pans as required for boiling down. At these works the process of graduation can be carried on for an average of 250 days in the year.

The boring operations were commenced at Stassfurt on the 3d April, 1839, and in June, 1843, had penetrated to the rock salt region. In January, 1851, when it had reached a depth of 1,851 feet, the liquor from the bores contained—

Sulphate of magnesium.....	4'01
Chloride of magnesium.....	19'43
Chloride of potassium.....	2'24
Chloride of sodium.....	5'61

Total salts..... 31'29

However, in 1848, Professor Marchand gave it as his opinion that the salts were not mixed in the manner represented by the brine, but that pure rock salt would be found at the bottom with the more soluble salts overlying it; and so much weight was given to his opinion that in December, 1851, after having penetrated to a depth of just as many feet as there were then years in the Christian Era, the sinking of the shaft "Von der Heydt" was commenced, followed in January, 1852, by that of the shaft "Von Monteuiffel;" and in 1856 the pure salt was found 1,066 feet from the surface.

The shaft passes through—1st, 27 feet of alluvial soil; 2d, 576 feet of sandstone, with some schist and grey limestone; 3d, 192 feet of gypsum and anhydrite; 4th, 21 feet of bituminous matter mixed with anhydrite and common salt—making in all 816 feet. Next there is 158 feet of abram or potash salts, the value of which was not recognised at first, but which now play a very important part in the industry of the country. The shaft then passes through 92 feet of rock salt, the upper portion of which is rather impure, being mixed to a considerable extent with anhydrite. This makes a total depth of 1,066 feet, and at this point the lateral workings were commenced. These consist of large galleries, the principal of which are from 40 to 60 feet broad, 20 to 25 feet in height, and about 200 feet long.

The salt is wrought in a manner somewhat similar to our long wall system, a series of holes of sufficient depth, about 6 feet or so, are drilled in the face of the salt about 5 feet from the floor, and this depth of material is removed by a series of small blasts. This operation is repeated until a considerable space has been cleared under the overhanging mass of salt. Bore-holes are then drilled close to the roof, and by a series of simultaneous blasts, a large mass of salt is dislodged. In one of those halls or galleries which we visited there was lying on the floor a mass of between two and

* Read before the Chemical Section of the Glasgow Philosophical Society, January 13, 1863.

three thousand tons which had been removed in this manner a few days previously. A number of boys are employed to pick out the pieces of pure salt, which only requires grinding to fit it for domestic use. The salt is removed to the pit bottom in hatches running upon rails, exactly similar to those in use in our own coal pits. From this they are lifted to the surface by an engine of 130 horse-power, and removed to the grinding mills, of which there are twelve at the mines. There is also a 200 horse-power engine for pumping, which lifts 13 cubic feet of water per minute.

The workings into the potash salts are opened on the other side of the shaft from the common salt galleries, for although the salts are deposited one on the top of the other, still as they dip at an angle of 30° they are all wrought from the one level.

The total thickness of the salts is 1,197 feet, and this may be said to consist of—

Rock salt.....	989 feet
Anhydrite.....	36 "
Polyhalite.....	13 "
Kieserite.....	51 "
Carnallite.....	98 "
Hydrated chloride of Magnesium.....	13 "

This gives a composition of—

Chloride of sodium.....	85.82
Sulphate of calcium.....	4.88
Sulphate of magnesium.....	4.70
Sulphate of potassium.....	0.40
Chloride of magnesium.....	2.53
Chloride of potassium.....	1.67
	100.00

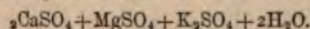
We will now consider the beds *seriatim*, beginning with the lowest, which is called the *anhydrite region*, and consists of 685 feet of pure rock salt interspersed with thin layers of anhydrite a quarter of an inch or so thick, and dividing the salt at intervals of from one to seven or eight inches. The salt is pure and colourless when pulverised.

The anhydrite is anhydrous sulphate of calcium, and contains a small quantity of a bituminous matter which imparts to it its char grey colour; traces of organic remains are also proved by the presence of a gas containing carburetted hydrogen which, according to Bischof, has the following composition:—

Carburetted hydrogen.....	85
Carbonic acid.....	3
Atmospheric air.....	12
	100

It is present in quantities of about 3 c.c. per kilogramme in the rock salt and about 8 c.c. in the kali salts. It presents the appearance of air bubbles in the transparent crystals. The specific gravity of anhydrite is 2.968, and it is soluble in water to the extent of 1 part in 500.

In the second or *polyhalite region* we have, besides the common salt and sulphate of lime, a deposition, from what might be considered the mother liquors, of the sulphates of potassium and magnesium which have combined with the sulphate of calcium to form the salt polyhalite, from which this division takes its name; its composition is given on the table:—



It has a specific gravity of 2.720 and is immediately decomposed by water. Specimens of it are seldom found pure, as they generally contain from 2 to 6 per cent of chloride of sodium. This bed is about 200 feet thick, and has an average composition, according to Steinbeck, of—

Chloride of sodium.....	91.20
Anhydrite.....	0.66
Polyhalite.....	6.33
Hydrated chloride of magnesium.....	1.81

the upper layers, however, being the more impure.

In the third or *kieserite region* the gradual disappearance of the more insoluble salts is made manifest, for it contains on an average only 2 per cent of anhydrite, and about 60 per cent of common salt, and from 17 to 20 per cent of kieserite, which is monohydrated sulphate of magnesium, the former being— $\text{MgSO}_4 + \text{H}_2\text{O}$. Specimens found in the mine generally contain from 1 to 2 per cent of chloride of sodium or magnesium; it is amorphous, greyish white, and transparent, and in the air has a tendency to pass into epsoms, becoming opaque during the transformation; it is soluble in rather more than twice its weight of water (40.9 parts in 100 H_2O). When the quantity of water is not sufficient for complete solution this salt has the peculiar property of absorbing a certain quantity of it and setting into a hard mass, more resembling a piece of flint than anything else, and with, of course, a considerable increase of volume.

In the fourth and last division, which is called the *carnallite region*, the insoluble salts are entirely gone, and even the common salt gives place in quantity to the more soluble carnallite, the average composition being:—

Carnallite.....	55
Common salt.....	25
Kieserite.....	16
Hydrated chloride of magnesium.....	4

Carnallite, when pure, consists of $\text{KCl} + \text{MgCl}_2 + 6\text{H}_2\text{O}$, having a specific gravity of 1.618, and dissolving in about one and a half times its weight of water at 18°C ; it is crystalline, clear, and colourless, but as found in the mine it varies from pure white to a deep red colour, owing to the presence of minute quantities of peroxide of iron. This peroxide of iron, when separated from the salts, presents the appearance of a coppery bronze powder, but when viewed under the microscope it is found to consist of distinct crystals of exceedingly beautiful appearance, varying in colour from golden yellow to dark red.

The carnallite is very deliquescent, and, on exposure to a damp atmosphere, the chloride of magnesium gradually drains away, leaving the chloride of potassium behind. This probably accounts for the presence of sylvin, or pure chloride of potassium, small quantities of which are found underneath the carnallite; it is rather more abundant in the Anhalt mine, and this would further tend to prove the theory that it is the product of the decomposition of carnallite, as the chloride of magnesium is found to preponderate in the lower lying level of the Stassfurt mine as *tachydrite*.

Sylvin is variously coloured, and has a bright shining appearance, which has been not inaptly compared to mother-of-pearl. Its specific gravity is 2.025, and 34.5 parts of it dissolve in 100 of water at 18°C .

It is occasionally found in large perfectly transparent crystals, which, according to Professor S. Magnus, of Berlin, are as transparent to heat as rock salt; and this diathermic property does not change with the tempera-

ture of the source of heat any more than rock salt does, and which has hitherto been the only substance known to possess the latter quality.

The tachydrite already mentioned is a salt having the same composition as carnallite, but in which the potassium is replaced by calcium, its formula being $\text{CaCl}_2 + 2\text{MgCl}_2 + 12\text{H}_2\text{O}$. It is very deliquescent and very soluble, 100 parts of water at 18°C . dissolving 160.3 parts of the salt; it is the only salt which raises the temperature of the water during solution, all the others having the property of lowering it during that operation.

Besides sylvin and tachydrite, there exists also, though in such irregular quantities that it cannot be calculated upon with certainty, a salt called kianite, having the following composition:— $\text{MgSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$. It is evidently the product of a secondary decomposition, arising from the action, probably, during a low temperature, of sulphate of magnesium upon chloride of potassium.

We also have what is probably the most peculiar and unaccountable compound in these mines—viz., boracite, the composition of which is $6\text{MgO}, 8\text{B}_2\text{O}_3 + \text{MgCl}_2$ (sp. gr. 2.3); it is found scattered all over the deposit in nodules varying in size from the most minute up to 7 or 8 inches in diameter, and, although occurring in the most soluble salt beds, is of itself almost insoluble in water, and, in fact, is with difficulty decomposed by acids; but its greatest peculiarity is, that it always, and without exception, contains a kernel of the easily soluble carnallite or tachydrite; it does not exist in any great quantity, the annual yield being somewhere about 10 tons. A small quantity of bromine is also found in this region, existing as bromide of magnesium; caesium and rubidium can also be detected; but hitherto all attempts to prove the presence of either lithium or iodine have been without success.

The ingredients in this region do not exist as a homogeneous mass, but are deposited in distinct layers, which repeat themselves frequently, and vary in thickness from a mere line to several feet.

It is from the impure carnallite that the manufacture of muriate of potash is so largely carried on in the neighbourhood. This salt, which is coarsely ground at the mines, has an average composition of—

Chloride of potassium.....	16
Chloride of magnesium.....	20
Chloride of sodium.....	25
Sulphate of magnesia.....	10
Water.....	29
	100

It also contains small quantities of sulphate of lime and bituminous matter, which occasion the manufacturer some considerable trouble, as in strong solutions they are light and flocculent, and, consequently, somewhat difficult to settle.

The manufacture of the muriate is entirely a question of the solubilities of the various salts, the key to which is the fact that the double salt of chloride of potassium and magnesium forms only from solutions containing exactly double the quantity of chloride of magnesium which exists in the carnallite. You will find it stated by various authorities that the "carnallite crystallises only from solutions containing a large excess of chloride of magnesium," but this has been proven by experiment to be a definite chemical quantity, viz., 4 parts of chloride of magnesium, and 1 part

of chloride of potassium, or, in other words, 2 parts of chloride of magnesium, hold in solution up to a certain strength 1 part of carnallite. So that on dissolving the crude salt in water, the chloride of magnesium takes up its quantity of chloride of potassium, whilst the remainder crystallises out as muriate, mixed with common salt and a small quantity of sulphate of magnesia. The mother liquors are then further boiled down to obtain a crop of artificial carnallite, which in turn is treated in a similar manner to the raw salt, to obtain a further supply of muriate. The muriates produced vary in strength from 75 to 98 per cent.

Epsom salts are also prepared at some of the works from kieserite, whilst at others a considerable quantity of the double sulphate of magnesium and potassium, a compound containing one equivalent of each of the sulphates, combined with 6 atoms of water, is made.

This salt is largely used as a manure for the sugar beet. It is generally understood that the beet grows equally well with soda as with potash, but the cultivators prefer to use the latter, as it is nearly all recovered in the state of carbonate, and of course is greatly enhanced in value. This leads us to consider what would have been the present state of the potash trade had it not been for the opportune discovery of this deposit, previous to which our only sources of potash were the muriate and sulphate from kelp, principally wrought in Glasgow and the north of Ireland, and the carbonate or potashes of North America. Whether the supply has regulated the demand or not it is difficult to say; but it is a fact that the produce from the two last-named sources has rather increased than decreased, whilst we have in addition the large supply obtained from the Stassfurt deposits.

This, of course, has been followed by a corresponding reduction in price—muriates of 80 per cent., which in 1863 sold at £21 10s. per ton, can now be purchased for £8 10s.

The carbonate has not fallen in the same ratio owing to the increasing employment of it in the arts and manufactures.

There is, consequently, a great prize in store for the chemist who, by his ingenuity, can discover some more direct process than that at present in use for the conversion into carbonate of the vast quantities of chloride stored up in these German mines.

To the scientific chemist and geologist this deposit presents a vast field well worthy of attentive study and research.

The generally accepted theory is that it is the product of the slow evaporation of some vast ocean, by a process similar to that which is at present going on in the Dead Sea, the waters of which are supposed to have already been evaporated down to 1,300 feet from their original level. If we examine an analysis of this sea, we find that it contains $6\frac{1}{2}$ per cent. of chloride of sodium, $1\frac{1}{2}$ of chloride of potassium, $2\frac{3}{4}$ of chloride of calcium, $10\frac{1}{2}$ of chloride of magnesium, and about $\frac{1}{4}$ of bromide of magnesium. The sulphates have almost entirely disappeared, and, looking at the preponderance of the more soluble salts over the chloride of sodium, we are forced to the conclusion that there must be already deposited at its bottom a vast quantity of the latter salt.

The great salt lake of North America, and some others in the south of Russia and in Asia, which contain almost nothing but chloride of sodium, must be regarded as fresh water lakes, which derive their saline matter from some already formed deposits of salts.

In August, 1867, the Prussian government commenced boring for salt at Sperenberg, and at the end of August last year (1868), they had penetrated to a depth of 952 feet, principally through gypsum, when they suspended operations to admit of more powerful instruments and machinery being made. These being now supplied, the work is again going on. There is no doubt that they will reach the salt strata, and we await the result with considerable interest, to see if the potash salts exist there also.

There are others besides scientific men to whom these mines are a source of considerable interest. To the political economist they mean an almost inexhaustible supply of the "savour of the earth," employment to the people, trade to the country, and pounds, shillings, and pence to the merchant and manufacturer.

To the visitor, be he scientific or non-scientific, a visit to the mines will amply repay him for his trouble.

The appearance of the workings in the kali salt portion of the mine is no less beautiful than wonderful, and is so entirely unlike what we see in mines in this country that we are entirely at a loss for anything to which we can compare them, and it is utterly impossible for any description to prepare the visitor for the novel sight which meets his eye when he enters these workings for the first time.

All have heard of, and many have witnessed, the wonderful grandeur of the Mammoth and other caves of North America, with their unfathomable subterranean rivers, where size and form, together with the light and shade produced by the flickering torches of the guides, are what excites the admiration of the traveller.

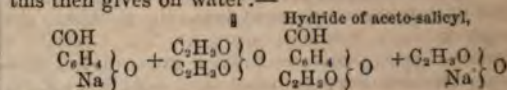
At Stassfurt we have neither the rivers nor the vast size, but we have space, which, in the bowels of the earth, seems great; we have beautiful form in the sparkling irregular angles formed by the pick and in the cavities left by the blast, to enhance which there is the magic charm of colour—colours of nearly every tint in the rainbow, passing from a deep purple through crimson, bright red, orange, and yellow, to snowy white, all in regular layers, but varying in size and arrangement, and from the angle of the dip each layer forming an almost perfect arch. The effect is further heightened by the nodules of boracite, which have the appearance (as graphically described by a Glasgow gentleman who is well acquainted with the mine) of having been shot at random from a park of artillery, so irregularly are they scattered, and so firmly are they imbedded in what meanwhile seems to us an altogether foreign place for them.

On the occasion of our visit, after having been conducted through such a gallery as we have attempted to describe, we left the main working, and after going a few yards through a narrower passage we found ourselves in a small chamber about 20 feet square—the preliminary opening for a new working. Underneath what is now the roof of this cavern there had been a lodgment of water, which had completely dissolved all the more soluble salts, and left the common salt and chloride of potassium in magnificent crystals of absolute purity; this formed a dome-shaped roof, which, sparkling and glistening in the light of our lamps, rivalled in beauty anything we had ever imagined of the celebrated Valley of Diamonds.

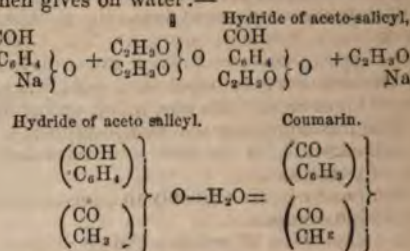
ON THE CONSTITUTION OF COUMARIN, COUMARIC ACID, AND MELILOTIC ACID.*

BY PROF. RUDOLPH FITTIG.

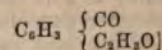
At the conclusion of his very interesting treatise on the artificial production of coumarin (*Jour. of Chem. Soc.* vol. vi., p. 53), Perkin develops his views on the formation and constitution of coumarin and coumaric acid. He assumes that in this reaction the hydride of aceto-salicyl, at a later date prepared by him (*Jour. of Chem. Soc.*, vol. vi., p. 181), at first results, and that this then gives off water:—



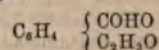
and



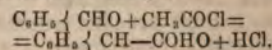
Coumarin would thus have the constitution—



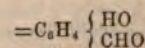
and coumaric acid—



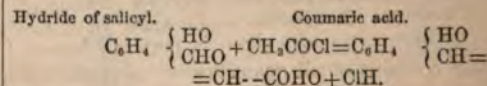
These formulæ, however, do not at all correspond with the behaviour of the two compounds, and at first sight even it appears improbable that an atom of hydrogen from the benzol residue should be used to the formation of water in the artificial production of coumarin. According to my view it is exceedingly probable that the reaction discovered by Perkin takes place in the same way as that discovered by Bertagnini in the artificial preparation of cinnamic acid from oil of bitter almonds and chloride of acetyl—



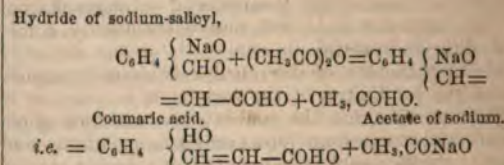
As hydride of salicyl is identical with hydride of oxybenzoyl—



it must give in the same reaction oxycinnamic acid, i.e. coumaric acid—

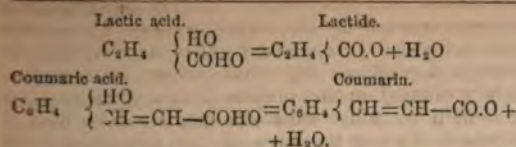


or—



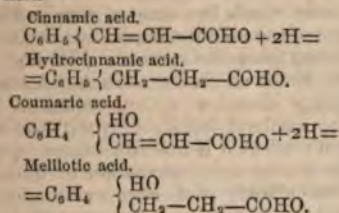
At the high temperature, and by the excess of the anhydride, the resulting coumaric acid is decomposed in the same manner as lactic acid by its transition into lactide, in the anhydride, i.e., coumarin and water—

* Communicated by the Author.



According to this, coumarin is the anhydride of coumaric acid, and its easy transition into this acid, in being treated with potassa, can be easily understood. The decomposition of coumaric acid into salicylic and acetic acid, speaks highly in favour of the view that its constitution is similar to that of cinnamic acid, and that it stands to this in the same relation as salicylic acid to benzoic acid.

By treatment with hydrogen *in statu nascendi*, coumaric acid is converted into melilotic acid, the same as cinnamic acid is converted into hydrocinnamic (phenylpropionic) acid—



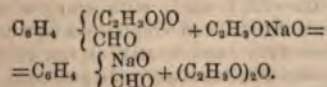
Melilotic acid is, according to this, oxyphenylpropionic acid. It differs from phenyllactic acid (Glaser) only in this that the HO replaces an atom of hydrogen in the benzol residue, while in the phenyllactic acid it stands in the place of an atom of hydrogen in the group CH₂ of the propionic residue.

Heated, melilotic acid yields the anhydride—

$\text{C}_6\text{H}_4 \left\{ \begin{array}{l} \text{CH}_2\text{-CH}_2\text{-CO.O.} \end{array} \right.$ (Zwenger), i.e., hydrocoumarin, which must also result by adding hydrogen to coumarin, if the conversion of the anhydride into the acid can be prevented.

The views on the formation of coumarin, expressed above, explain also thoroughly the observation by Perkin, that by treating the hydride of aceto-salicyl with acetic anhydride there results no coumarin, a fact perfectly incomprehensible, if we assume with Perkin, that the artificial production of coumarin is a result merely of the abstraction of water from the hydride of aceto-salicyl. Perkin has further observed the interesting fact, that coumarin results when hydride of aceto-salicyl is heated with acetic anhydride with an addition of acetate of sodium. According to Perkin's view, the influence of the acetate of sodium is perfectly incomprehensible, inasmuch as it is impossible that acetate of sodium or a compound of this salt with acetic anhydride could have a stronger dehydrating influence than anhydride, a fact which Perkin himself remarks.

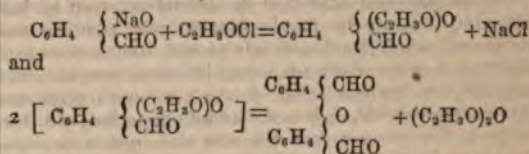
According to my view, the action of the acetate of sodium consists in this—that at an elevated temperature it at first gives rise to a reversed reaction, i.e., that it forms acetic anhydride and hydride of sodium-salicyl again—



The acetic anhydride acts only on this regenerated hydride of sodium-salicyl in the above-mentioned manner and forms coumaric acid, which, in its turn, breaks up into coumarin and water. This reaction explains,

at the same time, why hydride of aceto-salicyl can be prepared only at a low temperature.

Another reaction observed by Perkin may be explained in the same way; Perkin could not obtain hydride of aceto-salicyl by the action of chloride of acetyl on the hydride of sodium-salicyl. Instead of this the hydride of disalicyl resulted; but it is incomprehensible why hydride of aceto-salicyl should not result in this way, and, in fact, Cahours has prepared this compound by means of this method. The hydride of disalicyl of Perkin is only a product of decomposition of the hydride of aceto-salicyl at first formed—



and this reaction exhibits very clearly the tendency of the hydride of aceto-salicyl to give off acetyl at an elevated temperature. It makes the action of acetate of sodium, as assumed above, very probable.

Göttingen, Jan. 1869.

ON HYDROFLUORIC ACID.*

BY G. GORE, F.R.S.

A. Anhydrous Hydrofluoric Acid.

THIS paper contains a full description of the leading physical and chemical properties of anhydrous hydrofluoric acid, and also an account of various properties of pure aqueous hydrofluoric acid. The author obtained the anhydrous acid by heating dry double fluoride of hydrogen and potassium to redness in a suitable platinum apparatus (shown by a figure accompanying the paper), and states the conditions under which it may be obtained in a state of purity.

The composition and purity of the anhydrous acid are shown and carefully verified by various methods of analysis, both of the double fluoride from which it was prepared and of the acid itself; and particulars are given of all the circumstances necessary to insure reliable and accurate results. Nearly all the operations of preparing, purifying, analysing, and examining the properties of the acid were conducted in vessels of platinum, with linings of paraffin, sulphur, and lamp-black; articles of transparent and colourless fluor-spar were also employed in certain cases. Nearly all the manipulations with the acid were effected while the vessels containing it were immersed in a strong freezing-mixture of ice and crystallised chloride of calcium.

The pure anhydrous acid is a highly dangerous substance, and requires the most extreme degree of care in its manipulation. It is a perfectly colourless and transparent liquid at 60° Fahr., very thin and mobile, extremely volatile, and densely fuming in the air at ordinary temperatures, and absorbs water very greedily from the atmosphere. It was perfectly retained in platinum bottles, the bottle having a flanged mouth with a platinum plate secured with clamp-screws, and a washer of paraffin.

A number of attempts were made, finally with success, to determine the molecular volume of the pure anhydrous acid in the gaseous state, the acid in these cases being prepared by heating pure anhydrous fluo-

* Abstract of a paper read before the Royal Society, January 28th, 1869.

ride of silver with hydrogen in a suitable platinum apparatus over mercury. Particulars are given of the apparatus employed and of the manipulation. The results obtained show that one volume of hydrogen, in uniting with fluorine, produces not simply one volume of gaseous product as it does when uniting with oxygen, but two volumes, as in the case of its union with chlorine. The gaseous acid transferred to glass vessels over mercury did not corrode the glass, or render it dim in the slightest degree during several weeks, provided moisture was entirely absent.

The author concludes that the anhydrous acid he has obtained is destitute of oxygen, not only from the various analyses and experiments already referred to, but also, 1st, because the double fluoride from which it was prepared, when fused and electrolysed with platinum electrodes, evolved abundance of inflammable gas at the cathode, but no gas at the anode, although oxides are by electrolysis decomposed before fluorides; 2d, because the electrolysis of the acid with platinum electrodes yielded no odour of ozone, whereas the aqueous acid of various degrees of strength evolved that odour strongly; and, 3d, because the properties of the acid obtained from the hydrogen and fluoride of silver agree with those of the acid obtained from the double salt. He considers, also, that the acid obtained from pure fluor-spar and monohydrated sulphuric acid heated together in a platinum retort is free from oxygen and water.

The specific gravity of the anhydrous liquid acid was several times determined, both in a specific-gravity bottle of platinum, and also by means of a platinum float submerged and weighed in the acid. Concordant and reliable results were obtained; the specific gravity found was 0.9879 at 55° Fahr., that of distilled water being 1.000 at the same temperature.

The anhydrous acid was much more volatile than sulphuric ether. Its boiling-point was carefully determined, in a special apparatus of platinum, and was found to be 67° Fahr. Not the slightest sign of freezing occurred on cooling the acid to -30° Fahr. (-34.5°C.); and it is highly probable that its solidifying temperature is a very great many degrees below this. Its vapour-tension at 60° Fahr. was also approximately determined, and was found to be 7.58 lbs. per square inch. On loosening the lid of a bottle of the acid at 60° Fahr., the acid vapour is expelled in a jet like steam from a boiler; this, together with the low boiling-point, the extremely dangerous and corrosive nature of the acid, and its great affinity for water, illustrates the very great difficulty of manipulating with it and retaining it in a pure state. Nevertheless, by the contrivances described, and by placing the bottles in a cool cellar (never above a temperature of 60° Fahr.), the author has succeeded in keeping the liquid acid perfectly, without loss, and unaltered, through the whole of the recent hot summer.

The electrical relations of different metals, &c., in the acid were found to be as follow: at 0° Fahr.:—Zinc, tin, lead, cadmium, indium, magnesium, cobalt, aluminum, iron, nickel, bismuth, thallium, copper, iridium, silver, gas-carbon, gold, platinum, palladium.

Numerous experiments were made of electrolysing the anhydrous acid with anodes of gas-carbon, carbon of lignum-vitæ, and of many other kinds of wood, of palladium, platinum, and gold. The gas-carbon disintegrated rapidly: all the kinds of charcoal flew to pieces quickly, and the anodes of palladium, platinum, and gold were corroded without evolution of gas. The acid with a platinum anode conducted electricity much

more readily than pure water; but with one of gold it scarcely conducted at all. These electrolytic experiments presented extreme difficulties, and were conducted in a platinum apparatus (shown by a figure) specially devised for the purpose. The particulars of the conditions and results obtained are described in the paper. Various mixtures of the anhydrous acid with monohydrated nitric acid, with sulphuric anhydride, and with monohydrated sulphuric acid, were also electrolysed by means of platinum anodes, the particulars and results of which are also described.

To obtain an idea of the general chemical behaviour of the pure anhydrous acid, numerous substances (generally anhydrous) were immersed in separate portions of the acid in platinum cups, kept at a low temperature (0° to -20° Fahr.). The acid had scarcely any effect upon any of the metalloids or noble metals, and even the base metals in a state of fine powder did not cause any evolution of hydrogen. Sodium and potassium behaved much the same as with water. Nearly all the salts of the alkali- and alkaline earth-metals produced strong chemical action. Various anhydrides (specified) dissolved freely. Strong aqueous hydrochloric acid produced active effervescence. The alkalis and alkaline earths united strongly with the acid. Peroxides gave no effect. Numerous oxides (specified) produced strong chemical action, some of them dissolving. Some nitrates were not chemically affected, others (those of lead, barium, and potassium) were decomposed. Fluorides generally were unchanged, but those of the alkali-metals and of thallium produced different degrees of chemical action, those of ammonium, rubidium, and potassium uniting powerfully. Numerous chlorides were also unaffected, whilst those of phosphorus (the solid one only), antimony (the perchloride), titanium, and of the alkaline earth- and alkali-metals were decomposed with strong action, and generally with effervescence. The chlorates of potassium and sodium were also decomposed with evolution of chloric acid; the bromides of the alkaline earth- and alkali-metals behaved like their chlorides. Bromate of potassium rapidly set free bromine. Numerous iodides were unaffected, but those of the alkaline earth- and alkali-metals were strongly decomposed, and iodine (in some cases only) set free. The anhydrous acid decomposed all carbonates with effervescence, and those of the alkaline earth- and alkali-metals with violent action. Borates of the alkalis also produced very strong action. Silico-fluorides of the alkali-metals dissolved with effervescence. All sulphides, except those of the alkaline earth- and alkali-metals, exhibited no change; the latter evolved sulphuretted hydrogen violently. Bisulphite of sodium dissolved with effervescence. Sulphates were variously affected. The acid chromates of the alkali-metals dissolved with violent action to blood-red liquids, with evolution of vapour of fluoride of chromium. Cyanide of potassium was violently decomposed, and hydrocyanic acid set free. Numerous organic bodies (specified) were also immersed in the acid; most of the solid ones were quickly disintegrated. The acid mixed with pyroxylic spirit, ether, and alcohol, but not with benzol; with spirit of turpentine it exploded, and produced a blood-red liquid. Gutta-percha, India-rubber, and nearly all the gums and resins were rapidly disintegrated and generally dissolved to red liquids. Spermaceti, stearic acid, and myrtle wax were but little affected, and paraffin not at all. Sponge was but little changed. Gun-cotton, silk, paper, cotton wool, calico, gelatine, and parchment were instantly

converted into glutinous substances, and generally dissolved. The solution of gun-cotton yielded an inflammable film on evaporation to dryness. Pine wood instantly blackened.

From the various physical and chemical properties of the anhydrous acid, the author concludes that it lies between hydrochloric acid and water, but is much more closely allied to the former than to the latter. It is more readily liquified than hydrochloric acid, but less readily than steam; like hydrochloric acid, it decomposes all carbonates; like water, it unites powerfully with sulphuric and phosphoric anhydrides with great evolution of heat. The fluorides of the alkali metals unite violently with hydrofluoric acid, as the oxides of those metals unite with water; the hydrated fluorides of the alkali-metals also, like the hydrated fixed alkalis, have a strongly alkaline reaction, and are capable of expelling ammonia from its salts. It may be further remarked that the atomic number of fluorine lies between that of oxygen and chlorine; and the atomic number of oxygen, added to that of fluorine, nearly equals that of chlorine.

B. Aqueous Hydrofluoric Acid.

Under the head of the aqueous acid the author enumerates the various impurities usually contained in the commercial acid, and describes the modes he employed to detect and estimate them, and to estimate the amount of H F in it. The process employed by him for obtaining the aqueous acid in a very high degree of purity from the commercial liquid is also fully described. It consists essentially in passing an excess of sulphuretted hydrogen through the acid, then neutralising the sulphuric and hydrofluosilicic acids present by carbonate of potassium, decanting the liquid after subsidence of the precipitate, removing the excess of sulphuretted hydrogen by carbonate of silver, distilling the filtered liquid in a leaden retort with a condensing tube of platinum, and, finally, rectifying.

The effect of cold upon the aqueous acid was briefly examined, the result being that a comparatively small amount of hydrofluoric acid lowers the freezing-point of water very considerably.

The chemico-electric series of metals, &c., in acid of 10 per cent and in that of 30 per cent were determined. In the latter case it was as follows: Zinc, magnesium, aluminium, thallium, indium, cadmium, tin, lead, silicon, iron, nickel, cobalt, antimony, bismuth, mercury, silver, copper, arsenic, osmium, ruthenium, gas-carbon, platinum, rhodium, palladium, tellurium, osmium-iridium, gold, iridium. Magnesium was remarkably unacted upon in the aqueous acid. The chemico-electric relation of the aqueous acid to other acids with platinum was also determined.

Various experiments of electrolysis of the aqueous acid of various degrees of strength were made with anodes of platinum. Ozone was evolved; and with the stronger acid only, the anode was corroded at the same time. Mixtures of the aqueous acid with nitric, hydrochloric, sulphuric, selenious, and phosphoric acids were also electrolysed with a platinum anode, and the results are described.

HEATON'S STEEL AND IRON PROCESS IN ITS PRESENT STATE.

THE great and general interest created by Heaton's process is proportionate with its great scientific and commercial object, which is nothing more or less than

the production of good useful steel and wrought-iron from impure pig-iron. The use of impure pig is the chief point which distinguishes Heaton's process from other old and modern steel processes, as these have all required the employment of pure iron, or iron ore especially free from phosphorus and sulphur; this requirement very much limits the application of the otherwise highly valuable process of Bessemer.

Heaton's process differs from Bessemer's in employing nitrate of soda as the oxidising agent instead of atmospheric air, and both processes aim at the conversion of large masses at a time. As the great majority of existing iron works produce iron more or less contaminated with phosphorus and sulphur, Heaton's process would find an extensive field of operation if it were found fully to come up to what its promoters profess.

Our present knowledge of the process is confined to experiments only, the results of which are stated in reports (partly preliminary) by Professor Miller, Dr. Mallet, and Mr. Kirkaldy, and also in public correspondence; from these sources we are obliged at present to obtain our information and to form our opinion, as we have not ourselves seen the working of the process.

Prof. Miller's preliminary report describes Heaton's process thus:—

"On the occasion of our (namely, his and Dr. Mallet's) visit to the works of Langley Mill, on the 10th of July, 1868, 6½ cwts. of Clay Lane forge pig, No. 4, were charged into a hot cupola which contained no other iron; and immediately 6½ cwts. of Stanton forge pig, No. 4 (produced from ¾ of Northamptonshire brown ore, ¼ of Chesterfield clay ore, and ¼ of puddling cinder) was added, and the whole, when melted, was drawn off into a ladle, from which it was transferred to the converter.

"The 'converter' is a wrought-iron pot, lined with fire-clay. In the bottom of it was introduced a mixture of 160 lbs. of crude nitrate of soda, 40 lbs. of siliceous sand, and 20 lbs. of air-slaked lime; but these proportions in practice are varied considerably. On the top of this mixture a cast-iron perforated plate, weighing 95 lbs., was placed. The converter was then securely attached to the open mouth of a sheet-iron chimney, and the melted iron from the cupola (sample of this marked No. 4) was poured in.

"In about two minutes a reaction commenced; at first a moderate quantity of brown nitrous fumes escaped, these were followed by copious blackish, then grey, then whitish fumes, produced by the escape of steam carrying with it, in suspension, a portion of the flux. After the lapse of five or six minutes, an intense deflagration occurred attended with a loud roaring noise, and a burst of a brilliant yellow flame from the top of the chimney. This lasted for about a minute and a half, and subsided as rapidly as it commenced. When all had become tranquil, the converter was detached from the chimney, and its contents were emptied upon the iron pavement of the foundry.

"The crude steel was in a pasty state and the slag fluid; the cast-iron perforated plate had become melted up and incorporated with the charge of molten metal.

"The slag had a glassy, blebby appearance, and a black or dark green colour in mass.

"A mass of crude steel from the converter was then subjected to the hammer (No. 7).

"About 4½ cwts. of the crude steel were transferred to an empty, but hot reverberatory furnace, where, in about an hour's time, it was raised to a welding heat, and forged into four blooms under the steam hammer,

then rolled into square billets, which were cut up, reheated, and rolled into finished bars, varying in thickness from 1 inch to $\frac{1}{4}$ of an inch (No. 8).

"Three or four cwt. of the crude steel from the converter were transferred to a reheating furnace, then hammered into flat cakes, which, when cold, were broken up and sorted by hand for the steel melter (No. 9).

"Two fire-clay pots, charged with a little clean sand, were heated, and into each 42 lbs. of the cake steel were charged. In about six hours the melted metal was cast into an ingot (10 B).

"Two other similar pots were charged with 35 lbs. of the same cake steel, 7 lbs. of scrap iron, and 1 oz. of oxide of manganese. These, also, were poured into ingots (10 C).

"The steel, 10 B and 10 C, was subsequently tilted, but was softer than was anticipated.

"These results, on the whole, are to be considered rather as experimental than as average working samples.

"I have, therefore, made an examination of the following samples only:—

- No. 4.—Crude cupola pig.
 " 7.—Hammered crude steel.
 " 8.—Rolled steely iron.
 " 5.—Slag from the converter.

"I shall first give the results of my analysis of the three samples of metal:—

	Cupola Pig No. 4.	Crude Steel (7).	Steel Iron (8).
Carbon.....	2.830	1.800	0.993
Silicon with a little titanium.....	2.950	0.266	0.149
Sulphur.....	0.113	0.018	traces
Phosphorus.....	1.455	0.298	0.292
Arsenic.....	0.041	0.039	0.024
Manganese.....	0.318	0.090	0.088
Calcium.....	—	0.319	0.310
Sodium.....	—	0.144	traces
Iron (by difference).....	92.293	97.026	98.144
	100.000	100.000	100.000

"It will be obvious from a comparison of these results that the reaction with the nitrate of soda has removed a large proportion of the carbon, silicon, and phosphorus, as well as most of the sulphur. The quantity of phosphorus (0.298 per cent) retained by the sample of crude steel from the converter which I analysed, is obviously not such as to injure the quality.

"The bar-iron (No. 9) was, in our presence, subjected to many severe tests. It was bent and hammered sharply round without cracking. It was forged and subjected to a similar trial, both at a cherry red and at a clear yellow heat, without cracking; it also welded satisfactorily.

"The removal of the silicon is, also, a marked result of the action of the nitrate.

"It is obvious that the practical point to be attended to is to procure results which *shall be uniform*, so as to give steel of uniform quality when pig of similar composition is subjected to the process. The experiments of Mr. Kirkaldy on the tensile strength of various specimens, afford strong evidence that such uniformity is attainable.

"I have not thought it necessary to make a complete analysis of the slag; but have determined the quantity of sand, silica, phosphoric and sulphuric acid, as well as the amount of iron it contains. It was less soluble in water than I had been led to expect, and it has not deliquesced, though left in a paper parcel.

"I found that of 100 parts of finely-powdered slag, 11.9 were soluble in water. The following was the result of my analysis:—

Sand.....	47.3
Silica in combination.....	6.1
Phosphoric acid.....	6.8
Sulphuric acid.....	1.1
Iron (a good deal of it as metal)...	12.6
Soda and lime.....	26.1

100.0

"The result shows that a large proportion of phosphorus is extracted by the oxidising influence of the nitrate, and that a certain amount of the iron is mechanically diffused through the slag.

"The proportion of slag to the yield of crude steel was not ascertained by direct experiment, but, calculating from the materials employed, its maximum amount could not have exceeded 23 per cent of the weight of the charge of molten metal. Consequently, the 12.6 per cent of iron in the slag could not be more than 3 per cent of the iron operated on.

"In conclusion, I have no hesitation in stating that Heaton's process is based upon correct chemical principles. The mode of attaining the result is both simple and rapid. The nitric acid of the nitrate in this operation imparts oxygen to the impurities always present in cast-iron, converting them into compounds which combine with the sodium, and these are removed with the sodium in the slag. This action of the sodium is one of the peculiar features of the process, and gives it an advantage over the oxidising methods in common use."

The following is Dr. Mallet's opinion of the reality and commercial value of Heaton's process:—

"This process for converting crude pig-iron into wrought-iron and into steel, by the employment of nitrate of soda, in Heaton's patent converter, has been repeated at Langley Mills many times, in my presence. I have examined minutely into its details as applicable in practice on a large scale, and its results; and I have also considered the chemical researches made as to the materials used and products obtained, by Professor Miller, of King's College, and I have been present at experiments, conducted by Mr. David Kirkaldy, at his Testing Works, at Southwark, as to the physical qualities of the products which were obtained by this process, in my own presence, at Langley Mills. In view of all the facts that have come before me, I can affirm the following as truths established beyond question:—

"1st. That Heaton's patent process of conversion by means of nitrate of soda, is at all points in perfect accord with metallurgic theory. That it can be conducted upon the great scale with perfect safety, uniformity, and facility, and that it yields products of very high commercial value.

"2nd. That in point of manufacturing economy or cost it can compete with advantage against every other known process for the production of wrought-iron and steel from pig-iron.

"3rd. Amongst its strong points, however, apart from and over and above any mere economy in the cost of production are these:—It enables first-class wrought-iron and excellent steel to be produced from coarse, low-priced brands of crude pig-irons, rich in phosphorus and sulphur, from which no other known process, not even Bessemer's, enables steel of commercial value to be produced at all, nor wrought-iron, except such as is more or less either "cold-short" or "red-short." Thus, wrought-iron and cast-steel of very high qualities have been produced, in my presence, from Cleveland and Northamptonshire pig-irons rich in phosphorous and sulphur, and every iron-master, I presume, knows that first-class wrought-iron has not previously been produced from pig-iron of either of these districts, nor marketable steel from them at all.

"Heaton's process presents, therefore, an almost measureless future field in extending the manufacture of high-class wrought-iron and excellent steel into the Cleveland, and other great iron districts, as yet precluded from the production of such materials by the inferior nature of their raw products. It admits of the steel manufacture also being extended into districts and countries where fuel is so scarce and dear that it is otherwise impossible.

"I cannot, in this brief communication, point out the prospects which the employment of this system presents of greatly diminishing the existing waste of material, fuel, time, and wages, in the puddling process, and of lessening difficulties in relation to labour questions which beset that process, injuriously to the British iron trade. Nor can I adequately point out the large reduction in the original outlay for plant which this system admits of as compared with any other for equal annual out-put of iron and steel.

"Dr. Miller has proved, incontrovertibly, that the Heaton process does eliminate from the crude pig-iron almost the whole of the phosphorus and sulphur, the trace remaining being unobjectionable in the wrought-iron and steel produced, even when they have been made from the pig-irons known to be the richest in these injurious constituents of any make in Great Britain.

"The wrought-iron made in my presence from Cleveland and Northampton pigs and tested for tensile resistance also before me, bore a rupturing strain of 23 tons per square inch, and an elongation of nearly $\frac{1}{4}$ of the original unit in length. It is therefore iron of great strength and toughness, and yet probably by no means the very best that this process is capable of producing hereafter. It possesses those qualities which best fit iron for artillery, armour-plates, and iron ships or boilers.

"The tilted cast-steel, also made in my presence, from the very same pig-irons as the above, bore a tensile strain at rupture of above 42 tons per square inch with an elongation of $\frac{1}{12}$ th of the unit of length. It is, therefore, a remarkably tough and fine quality of steel, well suited for rails, ship-building, and all other structural uses. In a word, steel suited for any purpose known to the arts can be produced by this system from very inferior brands of pig-iron, from such as by no other known process could serviceable steel be made at all."

Mr. Kirkaldy has tested not only the bars of steel and steel-iron made in the presence of Dr. Miller and Dr. Mallet, but a number of other bars made by Heaton's process from different brands of pig-iron. The results of these experiments are given in the following tables:

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.		CONTRACTION OF AREA.		EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.	p.c.	p.c.		
1. Hammered cast-steel—made in the presence of Messrs. Miller and Mallet. Average of 5 samples.....	95,414	42'6	9'3	7'7		granular.
2. Ditto—made from 13 cwt. <i>Glengarnock Pig</i> , No. 2 (Scotch). Average of 2 samples....	99,481	44'4	16'9	8'5		{ 55 p.c. silky; 45 p.c. granular.
Average of 2 samples	84,877	37'8	3'9	4'1		{ granular. (peculiar).
3. Ditto—made of 7 cwt. of <i>Workington Pig</i> , No. 1, and 6 cwt. of <i>Stanton Forge Pig</i> , No. 4, mixed in the cupola in the usual way. Average of 3 samples.....	92,961	41'5	13'9	7'6		{ granular (the weakest of the 3 sample bars was 75 p.c. silky.)
4. Ditto—made from a charge of <i>Round Oak Pig-iron</i> only; the quantity of nitrate of soda used was 10 p.c. Average of 6 sample bars ($0'77 \times 0'78$).....	99,478	40'4	1'9	1'0		granular.
5. Ditto—made from a charge of 13 cwt. of <i>Butterleg Iron</i> , with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted into 4 bars of 1 in. and 4 bars of $\frac{1}{2}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square.....	100,019	44'7	11'4	5'5		granular.
Average of 4 bars 1 in. square.....	85,964	38'3	3'1	2'6		ditto.
6. Ditto—made from a charge of 13 cwt. of <i>Dowlais Iron</i> (No. 2), with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted in 4 bars of 1 in. and 4 bars of $\frac{1}{2}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square.....	95,470	42'6	3'2	2'5		granular.
Average of 4 bars 1 in. square.....	82,438	36'8	2'5	1'3		ditto.
7. Ditto—made from a charge of 13 cwt. of <i>Dowlais Pig Iron</i> (No. 3), with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., $\frac{1}{2}$ in., and $\frac{1}{4}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square.....	112,875	50'4	7'6	2'3		granular.
Average of 4 bars $\frac{1}{4}$ in. square.....	91,096	40'7	2'9	1'2		ditto.
Average of 4 bars 1 in. square.....	79,480	35'5	2'0	0'8		ditto.
8. Ditto—made from a charge of 13 cwt. of <i>Mid-lesboro' Forge Pig Iron</i> , with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., $\frac{1}{2}$ in., and $\frac{1}{4}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square.....	119,699	53'4	18'3	10'3		{ granular (peculiar).

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.	CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.	p.c.	p.c.
Average of 4 bars $\frac{1}{2}$ in. square.....	99,938	44'7	5'8	4'2 ditto.
Average of 4 bars $\frac{1}{2}$ in. square.....	96,713	43'2	5'8	4'4 ditto.
9. Ditto—made from pure <i>Workington Hamatite Pig Iron</i> , with $\frac{7}{8}$ p.c. of nitrate of soda; 6 bars $\frac{1}{2}$ in. square made as the other bars before tested.				
Average of the 6 bars	108,489	48'4	5'8	2'7 granular.
10. Ditto—made from White Forge Pig, produced from oolite ore, at the works of Baron d'Adelswardat Longwy, Moselle, France. The charges of nitrate of soda were as under.				
No. I.				
	c. qr.	lb.		
Longwy White Forge Pig.....	14	2	0	
Perforated plate, Clay Lane.....	1	0	0	
	15	2	0	
Nitrate of Soda.....	1	1	10	
No. II.				
	c. qr.	lb.		
Longwy White Forge Pig.....	14	2	0	
Perforated plate, Clay Lane.....	1	0	0	
	15	2	0	
Nitrate of soda.....	1	0	26	
No. III.				
	c. qr.	lb.		
Longwy White Forge Pig.....	14	2	0	
Perforated plate, Clay Lane.....	1	0	0	
	15	2	0	
Nitrate of soda.....	1	0	20	
No. IV.				
	c. qr.	lb.		
Longwy White Forge Pig.....	14	2	0	
Perforated plate, Clay Lane.....	1	0	0	
	15	2	0	
Nitrate of soda.....	1	0	14	
12 bars of $\frac{1}{2}$ in. cast-steel were made from No. 2 and No. 3 charges. Average of 6 bars.....	116,339	52'0	6'3	4'0 { granular (peculiar).
Average of 6 bars ..	110,864	49'5	30'1	12'5 { granular and silky.
11. Cast-steel, hammered, made from 3 charges of Grey Foundry Iron, produced at the works of M. de Wendel and Co., at Hayange, Moselle, France, from oolite ore, similar to the				

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.	CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.	p.c.	p.c.
Northamptonshire ore, with charges of nitrate of soda in the following proportions:—				
No. I.				
	c. qr.	lb.		
Hayange Grey Foundry Pig ..	14	2	0	
Perforated plate of Cleveland Pig ..	1	0	0	
	15	2	0	
Nitrate of soda ..	1	1	10	
No. II.				
	c. qr.	lb.		
Hayange Grey Foundry Pig ..	14	2	0	
Perforated plate of Cleveland Pig ..	1	0	0	
	15	2	0	
Nitrate of soda ..	1	2	2	
No. III.				
	c. qr.	lb.		
Hayange Grey Foundry Pig ..	14	2	0	
Perforated plate of Cleveland Pig ..	1	0	0	
	15	2	0	
Nitrate of soda ..	1	3	0	
The steel bars were made as before stated. Average of 4 bars $\frac{1}{2}$ in. square ..				
Average of 4 bars $\frac{1}{2}$ in. square.....	114,123	50'9	5'6	3'1 { granular (peculiar).
Average of 4 bars $\frac{1}{2}$ in. square.....	112,590	50'3	5'6	3'2 ditto.
Average of 4 bars $\frac{1}{2}$ in. square	84,740	37'8	2'6	1'3 ditto.
12. Cast-steel, hammered, made from a charge of 15 cwts. of white forge pig produced from oolite ore at the works of Baron d'Adelsward, at Longwy, France, treated with 1 cwt. 25 lbs. of nitrate of soda. The 6 bars of steel were made from cakes melted in the crucible, and tilted into $\frac{1}{2}$ in. square bars. Average of the 6 bars	109,951	49'1	8'7	6'0 granular.

Rolled steel-iron produced from the same kinds of pig-iron as the above-named, for the production of cast-steel, bore a rupturing strain of from 20'5 to 23'6 tons, and a contraction of area of from 14'2 to 49'6 per cent, and an extension of from 6'1 to 28'3 per cent. Hammered steel-iron of the same kind bore a rupturing strain of from 20'8 to 24'5 tons, a contraction of area of from 23'1 to 42'3 per cent, and an extension of from 11'3 to 23'6 per cent.

The following are the results of experiments on the tensile strength of various other kinds of iron and steel of known character made by Mr. Kirkaldy, and which we give here for the sake of comparison:—

NAMES. <i>a. Steel.</i>	MEAN BREAKING WEIGHT PER SQUARE INCH.	CONTRACTION OF AREA.
	Tons.	Per cent.
Turton's cast-steel for tools (forged)	59'3	4'7
Jowitt's double shear steel (forged)	52'9	19'6
Bessemer's patent steel for tools (forged)	49'8	22'3
Wilkinson's blister steel (forged)	46'6	21'4
Krupp's cast-steel for bolts (rolled)	41'1	34'0
Jowitt's spring steel (forged)	32'4	24'1
Mersey Company's puddled steel (forged)	31'9	35'3
Blackburn puddled steel (forged)	28'0	11'9
<i>b. Wrought Iron (round and square bars).</i>		
Yorkshire Low Moor	27'5	49'8
" Bowling		
" Farnley		
Lanarkshire $\diamond$ Govan $\diamond$	26'0	49'4
Lancashire best rivet	24'0	48'6
Staffordshire charcoal (4)	25'6	60'9
" BB scrap	26'5	52'0
Durham Best Best	23'9	18'3
Ditto	22'6	11'7
South Wales	18'5	9'8

When comparing these results with those obtained with Heaton's steel and iron it will be seen that Heaton's products are somewhat harder, as the contraction of area is generally greatest with the toughest and softest kinds. But on the whole the experiments before us are very satisfactory if we consider that Heaton's sample bars have been made experimentally only, and are consequently at a disadvantage with those of a regular manufacture, and if we further take into consideration the following circumstances influencing the tensile strength or tenacity of steel, and which can be followed better in a regular manufacture than in simple experiments:—

The Degree of Hardness.—Whilst a bar of unhardened good steel, 1 square inch (Prussian) in section, ruptures at a strain of 120,000 Prussian lbs. (wrought-iron bears only about 59,000 lbs.), the tenacity may be increased to 150,000 lbs. by properly hardening the steel. On the other hand, the tenacity decreases to 110,000 lbs. when the steel is hardened too much. The greatest hardness is therefore not combined with the greatest tenacity.

The Amount of Carbon contained in the Steel.—The cohesion of steel increases with its amount of carbon up to 1½ per cent, but beyond this limit the tenacity again decreases.

The Mechanical Treatment of the Steel.—Steel will be stronger and more homogeneous the longer and the more frequently it is forged.

The nature of the raw materials employed, and consequently the foreign substances contained in steel, also exercise an influence on the quality.

Professor Miller has analysed the *steel iron*, whose tensile strength has been ascertained by Mr. Kirkaldy to be 23 tons per square inch, a statement by no means contradictory to the composition of the iron as shown by the analysis. We much regret that Professor Miller has not also made an analysis of the *hammered cast-steel* whose tensile strength was found by Mr. Kirkaldy to be 43 tons per square inch.

These bars of cast-steel are thus described in Dr. Mallet's certificate of identification:—

"I certify that certain round rolled bars of Heaton's Patent Steel-Iron, marked and numbered, and also certain bars of *rolled cast-steel* and square bars of *tilted cast-steel*, also marked and numbered, were made on the 10th of July, 1868, at Langley Mills Steel Works, by Mr. Heaton's patent process, in my presence, and in that of Dr. Miller (except in so far as that Dr. Miller, through illness, was unable to wait for the '*pouring*' and *tilting*, &c., of the cast-steel), that the whole were made from a mixture of equal weights of Clay Lane No. 4 (Cleveland's) pig-iron, and of Stanton (BBB Pig) Northamptonshire iron, treated in Heaton's Patent Converter, and that the above bars of steel iron and cast steel were forwarded thence, in cases under my seal to Mr. Kirkaldy's Testing Works, London. That I there identified the said bars when taken out of the case in my presence, and that certain of those bars were tested before me as to the breaking strain and amount of elongation by Mr. Kirkaldy, and that the results of such testings are those referred to in my '*Preliminary Report*.'"

These bars, therefore, most probably belong to the steel which Professor Miller's preliminary report designates as 10 B or 10 C, or the bars were perhaps taken from both kinds; neither of them has been analysed, although this appears to be absolutely required to clear up the doubt still hanging over Heaton's cast-steel, concerning its proportion of phosphorus. It is rather an enigma, that, in the controversy on the value of Heaton's process, which has been carried on for some time in different periodicals and newspapers, Professor Miller's analysis of the crude steel has been taken as a basis for judging the hammered cast-steel, which undoubtedly has a different composition and less impurities than the original crude steel. We perfectly coincide with the opinion that part of the impurities are contained in the crude steel as intermixed or disseminated slag, and it remains to be proved how far these impurities, especially phosphorus, have been eliminated by the subsequent treatment of crude steel as described by Drs. Miller and Mallet.

The elimination of phosphorus is said to be one of the striking features of Heaton's process, but Professor Miller's analyses would appear to show that, on this special point, Heaton's process has no advantage over the common puddling process.

According to Professor Miller's analyses, the pig-iron employed contained 1'455 per cent of phosphorus, which proportion was reduced in the crude steel to 0'298 per cent, and in the steel-iron to 0'292.

For the sake of comparison, we give the following results of the puddling process:—

I. According to analyses of Calvert and Johnson:—

	Fe.	C.	Si.	S.	P.
Pig-iron	94'052	2'275	2'720	0'311	0'645
Blooms	99'338	0'269	0'120	0'134	0'139
Finished iron	99'490	0'111	0'088	0'094	0'117

II. The following is the result of Mr. Willis's analysis, made in Mr. Siemen's laboratory at Birmingham, of an inferior English pig-iron, before and after being puddled:—

PIG METAL.		PUDDLED BARS.	
Sulphur	0'08	Sulphur	0'017
Phosphorus	1'16	Phosphorus	0'237
Silicon	1'97	Silicon	0'200
Iron and carbon (by difference)	96'79	Iron (by difference)	99'546

III. In Ure's "Dictionary of Arts and Mines," ii., 726, the following illustrations are quoted:—

Pig-iron.....	3.030	per cent of phosphorus.
Puddled bar.....	0.838	" "
Rough down bar.....	0.572	" "

The finished bar was cold-short in the highest degree.

	Phosphorus.	Manganese.
	Per cent.	Per cent.
Pig iron.....	containing 2.60	7.20
Puddled bar..	" 0.30	0.30
Ditto.....	" 0.20	0.30
Finished bar..	" 0.11	

The finished bar exhibited none of the cold-short quality; it was exceedingly ductile; indeed, excellent horse-shoes were made from it.

Another question, important to Heaton's process, is to know the exact proportion of phosphorus that wrought-iron and steel may safely contain without being injured in their physical properties; and we are sorry to state that that proportion requires further investigation, although no research can ever lead to the determination of a definite amount, for the following reason:—Iron containing phosphorus takes, upon cooling, a crystalline texture, and thus becomes brittle or cold-short; but if forged immediately after heating, the crystalline texture and the cold-shortness will be lessened, and the more so the longer the iron is under the hammer.

Different investigators have recorded their opinions upon the influence of phosphorus upon wrought-iron and steel, thus:—

According to Karsten, there is little cause for apprehension respecting the quality of iron, as long as the phosphorus is below 0.5 per cent, and the only effect of a proportion of phosphorus up to 0.3 per cent is to make the iron harder without greatly diminishing its tenacity; and Karsten considers iron, containing not more than the latter proportion of phosphorus, as belonging to the best and strongest quality. He states, furthermore, that iron containing 0.5 per cent still stands the breaking test, but not when containing 0.6 per cent; this iron, however, can be bent at right angles, and struck over the anvil; and that containing from 0.75 to 0.80 per cent shows decided cold-shortness. Iron containing 1 per cent is very brittle, and can only be applied to a few uses.

According to Eggertz, wrought-iron containing from 0.25 to 0.3 per cent of phosphorus shows some cold-shortness, but is fit for various fine forge purposes, such as the manufacture of nails, wire, &c.

Eggertz also states that most varieties of steel of high repute contain from 0.01 to 0.02 per cent of phosphorus.

Bauerman, in his treatise on "The Metallurgy of Iron," p. 29, states:—

"Wrought-iron containing not more than 0.3 per cent of phosphorus is not sensibly affected in tenacity, but is only rendered somewhat harder; with 0.5 per cent it becomes somewhat cold-short, or incapable of being wrought cold under the hammer without breaking; with 0.8 per cent, the cold-shortness is very decided, and 1 per cent makes the metal very brittle."

Concerning Bessemer steel, Bauerman states, on page 365:—

"The best English pig-iron for use in the Bessemer process is that smelted from Cumberland hæmatite, about No. 1 or No. 2 in greyness. It should contain from 1½ to 2 per cent of silicon as a minimum, and not

more than 0.2 per cent of phosphorus. At Essen, in Westphalia, the limiting quantities of foreign matters in the pig-iron preferred for Bessemer steel making are, according to Jordan, as follows:—

Manganese.....	maximum 1.00	per cent.
Sulphur	" 0.04	"
Phosphorus.....	" 0.06	"
Carbon.....	minimum 5.00	"
Silicon.....	" 2.00	"

Concerning the Bessemer process, it is stated in Ure's "Dictionary of Arts and Mines," vol. iii., 770:— "As different samples were carefully analysed, it was ascertained that the red-shortness was always produced by sulphur, when present to the extent of 1-10th per cent, and that cold-shortness resulted from the presence of a like quantity of phosphorus."

It is greatly to be desired that Mr. Bessemer should publish his unquestionably rich experience of the influence of phosphorus and sulphur on steel.

We have already shown by analyses that the results of Heaton's process with regard to the elimination of foreign matters are similar to those of the puddling process. This, most probably, is the case, as the wrought-iron in both processes is produced in a pasty state, differing from the Bessemer process, which yields the wrought-iron in a liquid state.

Mr. Kirkaldy's experiments classify the one product of Heaton's process under wrought-iron, and the other under steel, as the former breaks at a burden of 23 tons per square inch and the latter at 43 tons, which is perfectly conformable with experience. However, we should like to have seen some further experiments on other qualities of the products of Heaton's process, such as property of welding, hardening, &c. And, though we consider the process open to improvement, it is, at all events, a step towards increasing the value of the inferior kinds of pig-iron; and it promises great results. To promote such an object is, we think, but just and fair, and, accordingly, we have endeavoured, in the preceding review, to give an impartial examination of the present state of the Heaton process.

We propose to give in a subsequent article the detailed statements of the actual cost of making steel and wrought-iron by this process.

In conclusion, we may state that an impartial French commission, headed, with the sanction of the French government, by M. Gruner, *Inspecteur-Général des Mines* of France, and Professor of Metallurgy in the Imperial School of Mines, has witnessed the conversion of their own impure pig-iron into steel, and verified the cost of production. A report of that commission is expected shortly, which will doubtless assist in elucidating the present obscure points in Heaton's process. We understand that M. Gruner has already reported that a sample of the slag was found to contain about 12 per cent of phosphoric acid—sufficient, indeed, to make it valuable as a source of that acid.

ON FOOD.*

BY DR. LETHEBY, M.A., M.D., ETC.

(Continued from Am. Repr., March, 1869, page 122.)

Unwholesome and Adulterated Food.

As regards the injurious quality of meat infected with parasitic disease there can be no question; and, perhaps, of all such infections, the most terrible is the *trichina* of

* The Cantor Lectures, delivered before the Society of Arts.

pork. Fortunately, it is a rare affection in this country, although it is often common in Germany. The pork infected with the worm is generally darker than usual, on account of the irritating or inflammatory action of the creature lodged in the muscles; and when the parasite is encysted the meat presents a speckled appearance—the minute white cysts containing the worm being just visible to the naked eye. Here are specimens of it in both its encysted and non-encysted conditions; and this diagram represents the appearance of the worm when it is examined under the microscope. It is, as you see, a minute thread-like worm, about the thirtieth of an inch in length, coiled up in a spiral form; hence its name, *trichina spiralis*. It is generally found in the human subject in an encysted state, when it has passed beyond its dangerous condition and has become harmless. In most cases, when thus discovered, there is no record of its action, and therefore it was once thought to be an innocent visitor; but we now know that while it was free—that is, before nature had barricaded it up in the little cyst, its presence was the cause of frightful disorder—killing about 50 per cent of its victims in terrible agony. In Germany there have been frequent outbreaks of the disease, which, for a time, baffled the skill of the most experienced physicians; in fact, we hardly know how long or how often the disease has attacked the pork-feeding population of Europe, for its actual nature was unknown until the year 1860, when Dr. Zenker, of Dresden, discovered the pathology of the disease. Since then there have been several visitations of it, as at Plauen, in Saxony, in 1862; at Hettstadt, near Eisleben, in 1863; and at Hedersleben, near Magdeburg, in Prussian Saxony, in 1866. In all these cases the same symptoms, or nearly the same, were observed; there was sometimes immediate disturbance of the digestive functions, but more commonly a day or two elapsed before any particular symptom was noticed, and then there was a feeling of lassitude, with a loss of appetite, and pains in the head and back. Then followed a serious disturbance of the alimentary canal, with vomiting and diarrhoea. This lasted for a day or two; and by the end of a week after the worm had been eaten, fever had set in, which became more and more severe, and by that time the young worms which had been hatched in the body had migrated to the distant muscles, causing the most excruciating pains, so that the patient, fearing to move his inflamed muscles, would lie motionless upon his back; and if he did not die in this state of the disorder, nature came to the rescue, and imprisoned the creature by surrounding it with a fibrinous cyst, where it lives for years, being ready at any moment to acquire activity when it is swallowed and released from its cell. Indeed, the way in which it becomes dangerous is this—flesh infected with the parasite is eaten; and the cyst being quickly dissolved by the gastric juice, the creature is set free. Finding itself in the midst of nourishing food, it rapidly grows, so that in two or three days it is three or four times its original size, and may be easily seen, like a bit of fine thread, with the naked eye. The worms are of different sexes, and they rapidly come to maturity—each female giving birth to from 300 to 500 minute thread-like worms, which immediately set out upon their travels, piercing the walls of the intestines and migrating to distant parts of the body, where they produce the terrible mischief I have described. Although the pig is the animal which is most commonly infected by it, yet it has been found in the muscles of dogs, foxes, badgers, sheep, moles, hedgehogs, rats, mice, frogs,

and most carnivorous birds, all of which must have been subjects of the disease, but none appear to suffer from it like man; even children are less affected by it, for they seem to sleep it away. Fortunately, there is an easy method of discovering its presence in animals, for the most certain seat of the creature is in the muscles of the eye; we have therefore only to examine these muscles with the microscope to declare whether the meat is infected or not; and, at the present time, the sausage-makers of Germany have the pork examined in this manner before it is used for food.

Other parasitic creatures, as measles in pork, and the smaller *cysticerci* of beef and veal, are found as little sacs or bladders diffused through the lean of the meat—the *cysticercus* or measles of pork being easily seen, for it is as large as a hemp-seed. Here are specimens of it in a fresh condition, which were seized in the city markets to-day; but the *cysticercus* of other animals is much smaller, and requires careful exploration to discover it. In both cases the sac contains a little creature with a sort of tuberculated head, crowned with a coronet of hooks, and having a bladder-like tail attached to it. Soon after it is swallowed, the enclosing sac is dissolved by the gastric juice, and the creature being liberated passes into the intestines, and there fixes itself by its little hooks, and quickly grows, joint after joint, into a tape-worm. In the case of the *cysticercus* of pork, it forms the variety of tape-worm called *tenia solium*, and in that of beef and veal it produces the *tenia mediocanellata*. The latter is the most common variety of it in the human intestines, and it is frequently seen where raw, or nearly raw, meat is made use of, as in Abyssinia and in Russia, where children are allowed to suck a piece of raw beef, on the supposition that it has a strengthening property. Each segment of the worm is an independent creature, containing myriads of ova, and when passed by the bowels, it gets with the manure upon the land and is eaten by pigs, oxen, and goats; the ova are then hatched in the stomach, and they pass, as in the case of the *trichinia*, through the walls of the intestine, and migrate to the muscular tissues of the body, where they become encysted, and form the little sacs or measles, which remain dormant for years, though they are ever ready to become tape-worms directly they are eaten. In this manner the creature is perpetuated, first as a tape-worm with joints in the intestines of one animal, and then as a measles or larva in the muscle of another, and then again as a tape-worm. By a like process the *tenia chinococcus*, or little tape-worm of the dog, becomes the hydatid in man and other animals. In Iceland the dogs are very liable to this infection, and the cattle and sheep, as well as man, suffer from the hydatid of it. The subject has been well-investigated by Dr. Leared, who has shown that the practice of giving the diseased offal of the slaughtered animals to dogs causes tape-worm, and the dogs drop the segments of the worm filled with ova, upon the pastures and into running water. By this means they enter the bodies of cattle and sheep, and even of man, and then, as in the last case, the ova quickly become developed, and the young hydatid or larva tape-worm, piercing the walls of the alimentary canal, migrates to distant parts, and finding a suitable nidus for its growth, it slowly becomes a large bladder-like hydatid. In the case of the sheep it often selects the brain for its habitat, and produces the disease called staggers; in the oxen it grows in the peritoneal cavity; and in man it haunts the liver, occasioning frightful disturbance of the system, and

causing one-sixth of the total mortality of that country. Here are specimens of the disease from the human subject.

Again, there is another class of parasite, called *trematoda* or flukes, which infest the livers and intestines of men and herbivorous animals. The most common of them is the *distoma hepaticum* or liver-fluke of the sheep. In wet seasons the animal is so constantly infested with them, and suffers so much emaciation from them, that the disease is called the rot. You have before you infected livers which were seized in our public markets this very day, and there is no difficulty in obtaining specimens of them at almost any time. A few years ago (1863), when Professor Brown was lecturing on the liability of animals to disease from the present mode of feeding them, he said that once, when he wanted some animals for dissection, and applied for them to a large butcher, he received back five or six animals, which, though in a bad state of rot, were dressed for the market; and he was told by a certain individual not far from London, that within the space of six months he had killed no less than 750 of such animals, in a state of extreme disease, and he believed they were all sent to market and sold for food. What becomes, he says, of the hundreds and thousands of rotten sheep which we see in the fields? To bury them would require whole catacombs; the real catacombs are the intestinal canals of the human body. The way in which the disease is produced in sheep is curious. Ova are passed from the gall-bladder of infected animals into the intestines, and so upon the land; finding a moist situation they are soon hatched into ciliated embryos, which swim about and become developed into cylindrical sacs of minute hydatids; these attach themselves to some mollusc, as a small snail. In wet weather the infected snails crawl upon the grass, and are eaten by the sheep, and then the hydatid speedily changes his condition and becomes a fluke. When it is found in the body of man it has, perhaps, been drunk with water or eaten with some aquatic plant, as water-cress, &c.

Our safety against these intruders is to cook the meat thoroughly.

The flesh of animals that have been excited before death, as by overdriving, or by torture, has frequently proved unwholesome. A remarkable instance of this is quoted by Liebig, in his "Letters on Chemistry," where a family of five persons were made seriously ill by the flesh of a roebuck which had been caught in a snare, and had struggled violently before death.

It is, moreover, a curious fact, that meat may be even poisonous from the nature of the food made use of by animals shortly before they are killed; and this, too, without any indication of disorder in the animals themselves. Hares which have fed upon the *Rhododendron chrysanthemum* are frequently poisonous; the same is the case with pheasants in Pennsylvania and Philadelphia, which feed during the winter and spring on the buds of the laurel (*Calmyia latifolia*); and I have known many instances of serious mischief from prairie birds which are now largely imported into this country from America, and I attribute it to the food made use of by the bird. In certain districts of North America, especially on the Alleghany mountains, the flesh of all the cattle is poisonous, and so also is the milk they yield, and the cheese which is made from it. Oysters, mussels, lobsters, and crabs have frequently caused disturbance of the human system; and the probability is that they were made unwholesome by

the food which they had eaten. A singular case is recorded in the medical journals of France in 1842, where a whole family at Toulouse were poisoned by a dish of snails, the animals having been gathered from a poisonous shrub (*Coriaria myrtifolia*); and it is not at all uncommon for honey to be unwholesome, on account of its having been collected by bees from poisonous plants. The honey of Trebizond, for example, has long been notorious for its deleterious properties; it poisoned the soldiers of Xenophon during the famous retreat of the ten thousand. Pliny, too, speaks of it; and to this day its intoxicating effect is frequently witnessed. It arises, no doubt, from the plants, chiefly the *Azalea pontica*, from which the honey is gathered. Mr. Barton has given us a similar account of the poisonous quality of the honey gathered by bees from the savannahs of New Jersey, where the *calmyia* and *azalea* are the principal flowering shrubs. As with the followers of Xenophon, all who eat of the honey become intoxicated to a high degree; and even when made into metheglin, it poisons all who partake of it, causing dimness of sight, giddiness, and then delirium, with sometimes a fatal termination.

Occasionally we have examples of food which is of itself poisonous. This is so with many of the fish in tropical seas, and especially of the West Indies. Dr. Burrows has given us a long list of them; and it would seem that the yellow-billed sprat (the sardine doré of the French, and *Clupea thryssa* of naturalists), the toad or bladder-fish (*Aploctylus punctatus* or *Tetraodon* of Cuvier) and the grey-snapper (*Coracinus fuscus major*) are the most venomous; and that being eaten by larger fish, as the *Baracosta*, and various species of perch, as well as the conger-eel, the dolphin, the globe fish, &c., it causes these to be poisonous also. The yellow-billed sprat is so virulent in its action on the human body that both Europeans and negroes have been known to expire with the fish in their mouths unswallowed; and the toad or bladder-fish is scarcely less dangerous. Sir John Richardson has described the effects of it on two sailors, the boatswain's mate and purser's steward, of the Dutch brig of war *Postilion*, while lying at anchor in St. Simon's Bay, at the Cape of Good Hope, in September, 1845. The men were warned that the fish was poisonous, but believing that the liver was wholesome, and rather a delicacy, they cooked it, and ate it directly after their twelve o'clock dinner. In ten minutes the boatswain's mate was so ill that he could not stand; his face was flushed, his eyes glistened, his lips were swollen and rather blue, his forehead was covered with a cold perspiration, and his pulse was weak and fluttering. He was, however, quite conscious, and complained of pain and constriction of the throat, and he had a desire to vomit. In a few minutes more he became paralysed, his eyes were fixed, his breathing was laborious, his face was pale though his lips were livid, and in seventeen minutes he was dead. The other man exhibited the same symptoms, and died in twenty minutes. Sir John Richardson says the fish was not more than six or eight inches in length, and the liver of it, which they had eaten between them, could not have weighed more than half an ounce.

The symptoms occasioned by the poisonous fish of the tropics are always of two kinds—there is either great irritation of the stomach and bowels, like cholera; or there is rapid prostration of the vital powers, and death by syncope or convulsions. These effects have been long known both to natives and Europeans, and were called by the Spanish colonists of tropical America,

Siquatera. They are more frequently observed at certain seasons of the year than at others, and hence they are thought to be due to certain physiological changes in the body of the fish, or to the food which it has eaten. In some cases the roe, in others the liver, or the digestive organs, are the most poisonous parts of the fish; and in the case of the *Maletta venenosa*, which inhabits the Caribbean sea, it is only poisonous when the sea is covered with a green monad, upon which the creature feeds. Happily for us, these dangers are confined to the tropics, although we sometimes suffer from a milder form of disturbance, as irritation of the skin and bowels, from eating unwholesome shell-fish.

Putrid meat is, perhaps, wasteful rather than actually injurious; but there are plenty of cases in which it has caused disease. Foderé tells us that at the siege of Mantua, those who were shut in the city, and were obliged to eat the half-putrid flesh of horses, suffered from gangrene and scurvy; and in Czant's history of Greenland there is an account of the death of thirty-two persons at a missionary station called Kangek, from a repast on the putrid brains of a walrus. Similar cases are recorded in all the books on legal medicine. Even game, when only sufficiently tainted to please the palate of the epicure, has caused severe cholera in persons unaccustomed to it; but, as Dr. Christison observes, "the power of habit in reconciling the stomach to the digestion of decayed meat is inconceivable. Some epicures in civilised countries prefer a slight taint even in their beef and mutton; and there are tribes of savages still further advanced in the cultivation of this department of gastronomy, who eat with impunity rancid oil, putrid blubber, and stinking offal." The Zulus of Natal, according to Dr. Colenso, are so fond of putrid meat that they call it *ubomi*, which literally means to be superlatively happy. But, as a rule, there is a natural abhorrence of tainted food, inasmuch, that with most persons, the mere commencement of decay is sufficient to excite disgust; and rarely do we find, except among savages, that an entire meal is made of putrid flesh. A little game or venison, or ripe cheese, at the end of a feast, with just a piquant touch of decay, is, perhaps, not objectionable; for it may, as Liebig supposes, promote digestion, by communicating its own quality of transformation to the rest of the food; but it is another thing to fill the stomach with putrid flesh, for if the corrective power of the gastric juice should fail, the effect of it might be serious. We have, indeed, abundant evidence of the terrible consequences of admitting putrid matter into the circulation, for they were once too common among those engaged in the dissection of the human body. In fact, the mere handling of decomposing animal matter for any time, will often produce disease of the hands or other parts of the body with which it comes into contact. Our safety, perhaps, in using such food is in the antiseptic power of good cooking; but this is not always an easy affair; for the tissues are generally so soft from decay that they will hardly bear the common action of heat; so that if they be boiled for any time they will fall to pieces; and if they be roasted, they will shrink without forming that delicious crust of osmazome which is characteristic of good meat. Let them, however, be cooked as they may, they always require a nice adjustment of rather strong flavours to make them palatable; and those who have dined in the cheap restaurants of Paris, or at the still worse table d'hôte of a German watering-place, will have experienced the art of the cook in this respect, in such dishes as *turbot en vol-au-vent*, *Raie au beurre noir*, *sole*

en matelote Normande, and in the various forms of fish *au gratin*; or *garne en saomis*.

But bad as this sort of tainted food is, it is nothing in comparison to the sausage poison, which is produced by a sort of modified putrefaction, to which the large sausages of Germany, and especially those of Würtemberg, are occasionally subject. According to an official return, there have been more than 400 cases of poisoning from these sausages in Würtemberg alone during the last fifty years, and of these about 150 were fatal. The effects are generally observed in spring, and mostly in April, when the sausages become musty, and acquire a soft consistence in the interior. They have also a peculiarly nauseous and rather putrid taste, and are very acid to test-paper. If eaten in this condition, they produce dangerous effects in from twelve to twenty-four hours—the first symptoms being pain in the stomach, with vomiting and diarrhoea, and dryness of the nose and mouth; then comes a feeling of profound depression, with coldness of the limbs, weakness and irregularity of the pulse, and frequent fainting. Fatal cases end with convulsions and oppressed breathing between the third and eighth day. The precise cause of these effects is still a mystery; some have thought that rancid fatty acids are produced during the decomposition of the meat; others that in the process of drying and smoking acrid pyrogenous acids have been developed; others that during the decay of the sausages, a poisonous organic alkaloid is generated. Liebig is of opinion that the effects are due to an animal ferment, which produces in the blood, by catalysis, a state of putridity analogous to its own, and that the molecular movements of the putrefactive change in the decaying meat are thus communicated to the living organism. M. Vanden Corput, who is one of the most recent investigators of the subjects, attributes the morbid action of such meat to the presence of a minute fungus, of the nature of a *sarcina*, which he calls *sarcina botulina*. This view is confirmed by the fact that there is always a peculiar mouldiness of the sausages; and the poisonous property is generally observed in April, when these cryptogamic organisms are most freely developed.

Similar effects have occasionally been produced by other kinds of animal food—as veal, bacon, ham, salt-beef, salt-fish, cheese, &c., and the food has usually been in a decayed and mouldy condition. It would be tedious if I were to detail, or even to enumerate the cases recorded by medico-legal writers; but I may, perhaps, refer to a few of them. In 1839, there was a popular fête at Zurich, and about 600 persons partook of a repast of cold roast veal and ham. In a few hours most of them were suffering from pain in the stomach, with vomiting and diarrhoea; and before a week had elapsed, nearly all of them were seriously ill in bed. They complained of shivering, giddiness, headache, and burning fever. In a few cases there was delirium; and when they terminated fatally, there was extreme prostration of the vital powers. Careful enquiry was instituted into the matter, and the only discoverable cause of the mischief was incipient putrefaction and slight mouldiness of the meat. Dr. Geiseler relates an instance where a family of eight persons were made ill by musty bacon; and M. Ollivier has given an account of six persons who were poisoned by mutton in a state of modified decay—four of whom died from it within eight days. In Russia, where it is the practice to eat largely of salt-fish in a raw condition, it is not at all uncommon to witness the dangerous effects of it when it has become mouldy or putrid; and, in fact, it is

within the experience of every one who is concerned in medico-legal inquiries, that serious symptoms are frequently traced to the use of food in a modified condition of decay. This is especially so with bad cheese, the effects of which on the constitution have been so severe that official investigations have been called for. These effects have been noticed at Schwerin (1823), at Minden (1825), at Hameln (1826), at Griefswald (1827), Frankfort (1828), and elsewhere; and they have been the subjects of interesting essays by Henneman, Hünefeld, Westrumb, and others. At first the effects were attributed to the copper vessels used in the dairies, and therefore the Austrian, Würtemberg, and Ratisburg States prohibited the use of that metal for such purposes; but the subsequent enquiries of Hünefeld, Sertürner, and other chemists, established the fact that no metallic poison was discoverable in the cheese. In the police report, which was published in Frankfort, in January, 1828, informing the public of numerous cases of poisoning in that city from spoiled cheese, it was declared that no poisonous principle could be detected by chemical reagents. Professor Hünefeld and, subsequently, Sertürner, were of opinion that the effects were due to certain poisonous fatty acids analogous to, if not identical with, caseic and sebacic acids; and they even describe the way in which they are produced in the cheese during the process of ripening—attributing them to the imperfect removal of the acid liquor from the curd when the cheese was made, or to the putrefaction of the curd before it was salted, or to the mixture of flour with the curd; but it is far more likely that the poisonous effects are due, as Vanden Corput supposes, to the presence of a peculiar mould or fungus. I have myself seen the most terrible consequences from the use of such cheese, and have failed to discover anything unusual in the acidity or other chemical reactions of the cheese. Hünefeld says, it is commonly of a yellowish red colour, and is soft and tough, with harder and darker lumps interspersed throughout it, and it has a disagreeable taste, and an acid reaction. The symptoms which it produces are very much like those of sausage poisoning—namely, irritation of the stomach and bowels, with great prostration of the vital powers. These effects have been witnessed not only in Germany, where the cheese is generally rancid and bad, but also in this country, and particularly among the small hill-farms of Cheshire, where limited extent of the dairies obliges the farmer to keep the curd for several days before a sufficient quantity of it is accumulated to make a large cheese.

I have said nothing of the improper practice of killing very young animals, especially calves, for food, before the tissues have had time to change from their uterine condition. On the Continent it is unlawful to kill or to sell calves for food that are not more than fourteen days old, but in this country there is no such restriction, and it is a common practice to dispose of the carcasses of newly-born or even foetal calves to the sausage maker; and as the flesh is sodden and insipid, he strengthens it with old, tough, and sinewy flesh. It has the advantage, moreover, of being miscible with any description of meat, and of taking any variety of flavour; in fact, it makes just that kind of sausage which is susceptible of any kind of flavour, and where, to use the expression of Dickens, "it's the seasonin' as does it." I cannot say that such meat is positively unwholesome, but it is nasty, and excites the same sort of disgust as an egg with a chick in it.

(To be continued.)

ON THE ACTION OF CARBOLIC ACID AS A THERAPEUTIC AGENT.*

BY JOSEPH HIRSCH, PH.D.

THE interest and importance of carbolic acid at the present day as a therapeutic agent were too tempting an invitation to experiment somewhat with this substance to be resisted, and although the experiments were so simple as to be hardly noteworthy, they still serve so far to illustrate the *modus operandi* of the acid, that I venture to recommend its trial in the treatment of some diseases in which, until now, the so-called expectative treatment, i.e., no treatment at all, except good nourishment, has been pursued as the only useful one. The starting point of these experiments was the power of the acid to coagulate albumen, which it does in virtue of its nature as an acid by entering into a union with the albumen. Reflecting upon the therapeutic action of carbolic acid, one is naturally led to connect it with its influence upon albumen, because this reaction is a very marked one, while albumen plays the prime part in the animal organism, being present in all those substances which supply the entire body or individual parts of it with the materials requisite for nutrition and the renovation of effete matters. It is the main constituent of the blood, the lymph, the chyle, and all serous fluids contained in the cellular tissue—in fact, all animal tissues are surrounded by an albuminous fluid, and all changes in the blood proceed from the albumen. For the purpose of my experiments I therefore took three series of solutions of albumen. The one was chemically pure albumen, prepared from white of egg in the well-known manner; the second was white of egg in its natural state, and also diluted to nearly one-half, i.e., the concentration in which it occurs in the blood; the third series were solutions of blood albumen, or serum, taken from cattle, sheep, and the pig, deprived as nearly as possible from the red corpuscles, so as to show the influence of the salts contained in the blood upon the behaviour of the albumen towards carbolic acid.

At the same time I prepared solutions of carbolic acid of different strength, with which to test the manner and extent of coagulation of the albumen. I dissolved the acid in glycerine, starting with solutions of 90 per cent of acid, each subsequent solution containing 10 per cent less of the acid, while I carried the fractions of 1 per cent down to 0.01 per cent, having nine solutions containing less than 1 per cent of carbolic acid, and eleven solutions containing 1 per cent and over.

The series of solutions of pure albumen were more or less coagulated during these experiments, even before they were coagulated by the acid. The coagula were less firm than those of the other solutions produced by acid of the same strength, of which even the most concentrated penetrated the entire mass of albumen much quicker than any of the other albuminous solutions.

The blood albumen also coagulated slightly faster than that of egg, but less so than the first mentioned series. Here the salts then seemed to act as diluents, rendering the coagulum more porous. This difference in the time of coagulation of the various solutions of the same strength was the main difference observable. In those of different concentration it appeared, in addition,

* Communicated by the Author, having been read before the Chicago College of Pharmacy.

tion, that in the more diluted solutions the coagulum grew in streaks downward, while in the concentrated solutions it progressed evenly over the entire surface of the albumen. In this case the solidification proceeded exceedingly slow.

The coagula produced by the most concentrated solutions were the most solid, but the least voluminous. The acid was added slowly to prevent a disturbance of the solutions of albumen, upon which the former floated, extending thus its action gradually downward. This took place very slowly with the dense solutions, the coagula of which appeared to be almost impenetrable to the acid, causing the substratum of liquid albumen to remain unchanged for a great length of time. The more diluted solutions produced a softer coagulum, easier penetrated by the excess of carbolic acid, while with the greatest dilutions the albumen coagulated in fibres, until finally only a turbidity was the result of the mixture.

The fibrous coagula were washed upon a filter with remarkable facility, while the coagula produced by greater dilutions partly passed through the filter, which, though finally, was clogged. These clogged filters I fastened to one end of glass tubes perfectly tight, of which I assured myself by keeping the tube filled partly with water for twenty-four hours. Testing, then, this primitive endosmotic apparatus with a solution of sodic chloride alongside of another one of the same size, constructed with bladder, I found the albumen apparatus to work somewhat faster than the other; but in consideration of the fact that the paper filter could not be drawn as tightly over the opening of the tube as the bladder for fear of tearing it, the quicker permeation of the filter may be ascribed to its greater surface. All the coagula placed under water at a temperature of about 80° F., for over three months remained apparently unchanged, although some of them during all this time were mixed with either one of the following substances, in which putrefaction had set in before their addition to the coagula. These substances were casein, blood, brewers' yeast, and leaven. There seems, then, to have remained a sufficient quantity of carbolic acid within the pores of the coagulated albumen to arrest even the decomposition of the substances added.

With these preliminary experiments, I compared the effect of carbolic acid upon the system; the application of a concentrated solution of the acid to the skin produced, in a short time, a white opaque spot of horny aspect, which soon peeled off. The same spot produced on a highly sensitive part of the epidermis, as on the tongue, at once loses its sensitiveness; and a feeling as of the presence of a foreign body as coating is experienced.

In both cases the opacity of the spot, by its resemblance to the opaque coagulated albumen, at once reveals the nature of the change produced by the acid. "The albumen of the blood, which through the numberless ramifications of the blood-vessels is carried to the skin for its nourishment, becomes coagulated." In this state it is solid, precluding the motion of liquids of its own kind within its substance, and with this motion nourishment and life. As lifeless, dead matter, the skin must necessarily peel off; it must, with the loss of vitality, be deprived of all the prerogatives of life, of feeling, as noticed above. Taking the coagulation of albumen as the immediate effect of applying carbolic acid to any organic substance, we shall find no difficulty in explaining the suspension of life without

its complete extinction in the microscopical beings known as contagion. They contain, no matter whether they are animalcules or minute plants—a question not yet definitely settled—albumen; blood albumen in the former case, vegetable albumen in the second.

Here the carbolic acid, coagulating the albumen on the surface of the corpuscle, forms an insoluble envelope, impenetrable to air and to further quantities of carbolic acid, which in this manner forms an obstacle to the entrance of greater quantities of itself into the interior of the small body. This then retains in its centre a minute portion unchanged, full of life, capable of increase under favourable circumstances, and protected from external influences by its coating of coagulated albumen. Such a corpuscle acted upon by carbolic acid may be represented by an egg exposed to boiling water for a few seconds. The coagulating influence of heat affects the superficial layer of albumen, which still encloses the rest of the egg in its raw state. All substances or processes producing the same coagulating effect upon albumen do in reality exert the same destructive influence upon contagion and miasma, but none possess other necessary properties qualifying them for this purpose as well as carbolic acid. Heat, which coagulates albumen, has been used successfully in the disinfection of places and clothing infested with the poison of cholera, small-pox, yellow fever, &c.; but while we can turn high pressure or even superheated steam into a room, a ship, &c., we cannot subject a cholera patient, or an animal infected with the cattle plague, to so high a temperature as to destroy the poison lurking within them; and if in diluted carbolic acid we have a remedy, which with such coagulation will destroy the activity of contagion without interfering with the process of life in the patient, we have found a desideratum which is at once a boon to mankind and a victory of science important beyond comparison. Other chemicals, as the mineral acids, their salts which coagulate albumen, also destroy contagion; but their destructive influence upon the animal organism in that state of concentration in which they coagulate albumen precludes their use in contagious diseases under the same circumstances, for similar reasons, under which superheated steam is unavailable.

On the other hand, carbolic acid in great dilution exerts a barely perceptible influence upon the vital process of the larger animals, while its power of destroying sporules is almost equal to that of the concentrated acid.

This apparent anomaly is easily explained on comparing its action to the parallel coagulation of a highly diluted solution of albumen by one similarly diluted of the acid. The diluted solution is as completely coagulated as a dense one; but the immense dilution places the particles of albumen at such great distances from each other that they can no more form a coherent mass after coagulation, but remain separately suspended in the liquid, rendering it opaque and milky in appearance. This liquid, although charged with insoluble albumen, will filter through paper, as also through the pores of all the tissues of the animal organism. The dilute carbolic acid introduced into the system will, in the same manner, coagulate the albumen and sporules it meets upon its passage in such subdivision that the coagulum can no longer form a dense coherent coating, as is the case during the application of the concentrated acid, while the minute particles of this coagulum, after filtering through the animal tissue, do no longer oppose an obstacle to the free passage of greater quantities of the carbolic acid or of the vital fluids.

On the other hand, the sporules, constituting the contagion, are so minute themselves that the limited sphere of action of the diluted acid still embraces a complete sporule, or a number of them, which thus have their vitality suspended as completely as by the concentrated acid.

The great divisibility, respective volatility of the acid, prevents its complete neutralisation by the albumen of the larger organism to the exclusion of that of the sporules, the albumen being a base of no great energy, especially if linked to as faint an acid as carbolic. Nevertheless for a complete curative effect the dose must be repeated, as the acid owns, in common with all other drugs, the property that the limit of its sphere of action is proportionate to its amount. The manner of action of the acid as shown illustrates the difference of its operation as a disinfectant from other substances used for that purpose, which are mostly oxidising agents acting upon the products of decomposition, like ammonia, hydric sulphide, &c., which are altogether out of the sphere of action of carbolic acid, because they are not capable of coagulation. They may partly be neutralised by the same, but being volatile, it is not superior in this respect to the ordinary mineral acids.

The great reducing powers of carbolic acid recommend it for the detection of hydric peroxide, as has been proposed lately. The addition of the last-named substance to a mixture of aqueous carbolic acid and ferrous sulphate produces a permanent green colouration. Here the carbolic acid prevents the oxidation of the ferric protoxide by the hydric peroxide, which, without its presence, takes place.

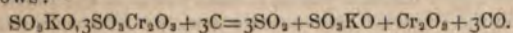
That this reducing action is a prominent factor in its mode of destroying contagion, by preventing oxidation, which is synonymous with life, there is but little doubt. For the kindred processes, like fermentation, have been found to be true processes of oxidation, and we are enabled to prevent or stop fermentation by various other reducing agents—for instance, the hyposulphites, the efficacy of which in various contagious diseases has also been well tested.

NOTE ON

THE UTILISATION OF CHROME ALUM.

BY M. F. JEAN.

THE manufacture of aniline green and violet, and of valerianic acid, gives abundant residues of chrome alum. These residues cannot be utilised as mordants, because, when calcined, they are insoluble in water, and therefore do not find a sufficient market, thereby considerably augmenting the net price of products prepared with bichromate of potash. Whilst endeavouring to turn these residues to account, I discovered that when chrome alum, previously mixed with three equivalents of carbon, is heated to redness, decomposition takes place as follows:—



If, on the other hand, chrome alum be decomposed with seven equivalents of carbon, the evolution of sulphuric acid is less than in the first case, and the mass taken up by the water yields sulphide of potassium and hyposulphite of potash: the sesquioxide of chromium obtained under these conditions must be separated, by washing in acidulated water, from a certain quantity of sulphide of chromium, Cr_2S_3 , formed by contact with the sulphide of potassium. It is better to decompose

the alum with three equivalents of carbon than with seven, because the decomposition is quicker and purer.

The industrial treatment of chrome alum is very simple; it consists of pulverising and mixing the alum with the carbon, and then decomposing it at red heat in a retort of refractory earthenware. The sulphuric acid passes into a series of bitubular flasks, containing either distilled water, carbonate of soda, or polysulphide of sodium. When sulphuric acid is no longer liberated, the decomposition is ended. The obturator of the retort is then withdrawn, and the mass, consisting of sulphate of potash and sesquioxide of chromium, is caused to fall into a cast-iron boiler, water is added, and the whole is boiled to dissolve the sulphate of potash, which is afterwards separated by crystallisation; the sesquioxide of chromium is placed to drain upon cloths, and then calcined to remove the water that remains. This oxide may easily be rendered chemically pure by washing it in a boiling dilute solution of carbonate of soda, thus removing all traces of sulphuric acid which had escaped the action of the pure water. The sesquioxide of chromium obtained by this process is of too dull a green to be used for printing paper or textile fabrics; but, on account of its purity, and the ease with which it may be treated, it is perfectly adapted for making bichromate of potash.—*Comptes Rendus*.

LECTURES.

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(FULLERIAN PROFESSOR OF CHEMISTRY IN THE ROYAL INSTITUTION.)

LECTURE III.

AIR—OXIDES—CARBON OR CHARCOAL.

(Continued from *Am. Repr.*, March, 1869, page 141.)

Now, carbon may exist in two states—in that in which it will burn, and in that in which it is already burnt. All our ordinary combustibles contain charcoal, but many of them—almost all indeed—also contain another substance. We know, in fact, that these substances contain charcoal, because when they burn they give rise to burnt or oxidised charcoal—that is to say, to carbonic gas; but there is another combustible called hydrogen, which is the gas known as inflammable air, and when this hydrogen burns it produces oxide of hydrogen instead of oxide of carbon, and oxide of hydrogen is water. Here is the dry hydrogen gas burning, and here is the water which is being produced by its combustion, and when, by means of magnesium wire, I illuminate the jar, you see what a very beautiful appearance is presented by the drops of the water on the sides of the glass vessel in which the combustion of the hydrogen has been going on. Well, then, as I have said, when carbon burns we get carbonic gas or oxide of carbon, and when hydrogen burns we get water or moisture produced, and water being an oxide of hydrogen,

* Reported verbatim, by permission of the Author, for this Journal.

and we recognise the presence of carbon or hydrogen in a combustible by the fact that, when burning, the one produces carbonic gas and the other water. Now, I will show you once again the production of this carbonic gas by the combustion of charcoal. We take our old test, the lime-water, and pour some of it into this glass; we then allow the air which has passed over the burning charcoal to bubble through the lime-water, and as carbonic gas is produced our lime-water turns milky. Now, instead of the current of air which we are using, we will turn a current of oxygen upon the burning charcoal, and you will see that it will then burn in a very different manner. [The experiment was performed, and the formation of carbonic gas by the combustion of the charcoal in oxygen was indicated by the clouding of the lime-water.] In this way you see that, whether we burn charcoal in oxygen or in air, the production of carbonic gas accompanies the burning.

Now let us turn our attention to some ordinary combustibles. We will first burn some ordinary coal gas from this burner, and notice what products our coal gas will furnish. To begin, we will take a bottle at present containing nothing but air, and hold it over our flame: now notice what takes place. You will first of all see that the interior of the vessel very quickly becomes dimmed or dewed with a film of water. Accordingly, coal gas by its burning produces water or oxide of hydrogen; hence we learn that the unburnt coal gas contains hydrogen. Now, does the burning of coal gas also produce carbonic acid? We shall very soon ascertain this by pouring into the bottle some lime-water, shaking it up for a minute or two, and then observing whether we convert our clear dissolved lime into insoluble chalk. [The lime-water test was applied as described.] You see that in this case chalk is produced, which shows that our coal gas contains charcoal.

As we have talked about coal gas in this way, I ought to call your attention to the manner of collecting it, and show you what sort of a substance it looks like when we get it in something like a definite quantity. I have a tube attached to the gas pipes, and from the end of this, which is under water, you see it is bubbling up, and is quite invisible. In a minute or two a jar full will be collected. It has all the appearance of ordinary air; it is quite invisible, and nobody can tell from its appearance that it contains charcoal any more than you could tell that the atmospheric air by which we are surrounded does so. Our cylinder is now filled with this ordinary coal gas, and we will proceed to set fire to it. You see the very rapid manner in which coal gas burns when it is ignited in this way.

We will next see how a candle behaves when burnt in a current of oxygen; and now I am going to call your attention to a somewhat different phenomenon. We place a lighted candle in this glass vessel and then turn on the oxygen; the candle is now burning in a current of oxygen. Whilst it is doing so, I will cut off the supply of the ordinary air, which is also being admitted to the vessel; but you see that this does not matter in the least while the candle is supplied with a current of oxygen gas. When, however, I remove the current of oxygen, and allow the candle to burn by the aid of the ordinary air, you see a great difference; it burns very dimly, and also smokes, and in the course of a minute or two it will go out. Now how is it that the candle smokes in this way? We can make coal gas do the same, and all that we have to do to produce this effect is to treat it much in the same way—to cut off the supply of air. If we do this we find that the coal gas also will smoke. Here it is burning in the ordinary way, and now if I bring down a piece of wire gauze upon it, and cut off the supply of air thus, you observe that we get a very considerable amount of smoke.

Now, how is that when the supply of air is cut off the burning candle and coal gas both deposit their carbon in the form of charcoal instead of yielding it in the shape of carbonic gas? Well, I will just direct your attention to the manner in which these ordinary combustibles burn in another gas, namely, chlorine—this green air, one of the

properties of which is that while hydrogen burns in it very readily, carbon or charcoal does not burn in it at all, and, accordingly, if we introduce a lighted taper into it, the hydrogen of the taper burns readily, but the carbon of the taper will not burn, and therefore the flame smokes very much. You see the taper continues burning when it is introduced into the gas, but the carbon which will not burn is liberated, and appears in the form of smoke instead of being converted into invisible carbonic gas. Here is a jar containing some chlorine, to which I will add some of the coal gas, and we will now set fire to the mixture. [A light was applied to the jar, and the mixture exploded with a sharp detonation.] You see the very vigorous manner in which the coal gas burns in chlorine; but you will also observe that the sides of the jar are covered with an abundant deposit of unburnt charcoal. When these hydrocarbon substances burn in a sufficient supply of air, both the carbon and the hydrogen burn. The hydrogen is converted into water and the carbon into carbonic gas; but when these substances burn in chlorine instead of in air, only the hydrogen burns, and the carbon, instead of passing into the burnt condition and becoming carbonic gas, makes its appearance in the unburnt condition of soot.

Again, if instead of burning the candle or the coal gas with a sufficient supply of air, we burn it with an insufficient quantity, the oxygen takes the hydrogen in preference, and this alone burns, the carbon being deposited without combustion. When we were burning this candle in oxygen both the hydrogen and the carbon burned, and there was no deposit of soot or charcoal; but when the charcoal burned in an insufficient supply of air, the hydrogen and carbon could not both undergo combustion; either the hydrogen alone must burn or the carbon alone, and the former did so in preference to the latter. Now, it is in this way that we generally obtain charcoal. Instead of burning the pieces of wood or materials from which charcoal is derived, with a sufficient supply of air, we burn them in an insufficient quantity, and in that case, the hydrogen undergoes combustion, and the carbon is left unburnt. Some very beautiful forms are frequently obtained in this process. Here is some straw which was burnt in the manner I have described. The hydrogen has been consumed, and the charcoal of the straw remains in this beautiful form. Here, again, are some nuts and kernels of fruit which have been burnt into charcoal, and in the same way we obtain wood charcoal and the numerous varieties of this substance which are familiar to us. Sufficient air to burn the hydrogen is admitted, but there is not enough to combine with the carbon, and thus we get it in a separate state. There is another way in which charcoal may be obtained. At a sufficiently high temperature the hydrogen separates from the carbon without burning, and this furnishes us with another means of obtaining charcoal. In consequence of the heat which we applied to the tube of porcelain to which I drew your attention in the early part of the lecture, the coal gas which has been passing through the tube has deposited a large quantity of charcoal on the white porcelain.

So much for the methods of obtaining charcoal. We must now pass on to the consideration of some of the properties of charcoal, and the most remarkable is its extreme porosity. An ordinary piece of this substance, such as that lying on the table, has the singular property of being able to absorb very many times its volume of gas or air, and accordingly we find that what looks like a piece of charcoal, pure and simple, contains many times its own bulk of air. I can show you this by means of the air-pump. If we place some charcoal in water under the glass of the pump, and then exhaust the air, you will see bubbles of air given off. Here we have a piece of charcoal buried under water, and on working the pump we can extract the air contained in the charcoal. [The piece of charcoal was subjected to the experiment described, and gave rise to an abundant stream of bubbles when the pump was worked.] You see the large

quantity of air which has been taken up by this piece of charcoal.

Now charcoal does not absorb all kinds of air with the same facility, but it absorbs some kinds far more readily than others. Here is a table showing you the absorption which one kind of charcoal will effect in respect to different gases:—

ABSORPTIONS OF GAS BY 1 CUBIC INCH OF COCOANUT SHELL CHARCOAL.

Oxygen.....	18 cubic inches.
Carbonic gas.....	68 "
Sulphuretted hydrogen...	100 "
Ammonia gas.....	170 "

A cubic inch of charcoal will absorb various quantities of different sorts of gas; but some kinds of charcoal absorb gas far more readily than others, and this is particularly the case with that obtained from the shell of the ordinary cocoanut. Let us consider what is the amount of gas which this form of charcoal will absorb. A cubic inch of the cocoanut shell charcoal can absorb 18 cubic inches of oxygen; it is, in fact, capable of absorbing the quantity of oxygen represented by this block. [The lecturer here took a piece of charcoal 1 cubic inch in size, and placed upon it a rod of deal, 1 inch square and 18 inches long. In the subsequent illustrations, rods 68 inches, 100 inches, and 170 inches long respectively, were employed to illustrate the quantities of carbonic gas, sulphuretted hydrogen, and ammonia gas absorbed by 1 cubic inch of charcoal.] Now you can scarcely form any idea of the amount of force which is required for that absorption. If we were to take 2 cubic inches of oxygen, and endeavour to compress them into the space of one, we should require the pressure of 15 lbs. weight; but to compress 18 cubic inches of oxygen into the space of 1 cubic inch, we should require eighteen times 15 lbs., which would be equivalent to about two hundredweights and a half. Here is a half hundredweight, and it is almost as much as I can lift. Now we should require about five such half hundredweights to compress 18 cubic inches of oxygen into the space of 1 cubic inch; but you must observe that the cubic inch of charcoal which can absorb these 18 cubic inches of oxygen, appears to be already full of the substance of the charcoal itself. There seems to be scarcely any space left; and what gas the charcoal will contain must occupy its pores. Now, if we imagine that the pores occupy even as much as a twentieth part of the whole mass, we should then require, not five times, but about one hundred times the pressure of this half hundredweight, to compress 18 cubic inches of oxygen into a cubic inch of charcoal. Nevertheless, so great is the absorptive power of this kind of charcoal that it gradually exerts upon the oxygen a compressing effect equal to the force of some 50 hundredweights.

With regard to carbonic gas, it has been found that a cubic inch of charcoal is capable of absorbing 68 cubic inches of carbonic gas, or the quantity represented by this rod [placing a rod 68 inches long on the cubic inch of charcoal]. Lastly, there are two gases which are the result of the decomposition of animal matter. When animals undergo decomposition they emit two kinds of gas—one called sulphuretted hydrogen, the other ammonia. Now charcoal has the property of fixing these two gases with still greater facility; and accordingly our 1 cubic inch of charcoal can absorb 100 cubic inches of sulphuretted hydrogen gas, or the quantity which is represented by this rod. And with ammonia gas, the power of absorption is even more striking: 1 cubic inch of charcoal is able to absorb 170 cubic inches of ammonia, or the quantity represented by this other rod. And you must remember that these gases are not compressed into only 1 cubic inch of space, but into the small pores or interspaces contained in the charcoal, which seems to be solid. Thus you may form some idea of the immense force which charcoal is capable of exerting in this way.

Let me give you one or two illustrations of this property.

I have, in this tube, some ammonia gas, and into this ammonia gas I will put a piece of charcoal. This is placed over mercury, and you will see that after a little while, the charcoal will gradually rise up in the tube, so as to absorb the whole of the gas, and the mercury will follow it, until the tube becomes completely full.

It is upon this remarkable absorption of different gases by charcoal that the efficacy of this substance as a respirator or ventilator depends, for it is found that when these gases are absorbed into charcoal, they have the property of acting upon one another with considerably increased activity. A striking illustration of this is afforded by the following experiment:—Here we have a glass jar, in the lower part of which is a partridge,—and I am afraid to tell you how long that partridge has been there, but at this time it is in anything but a pleasant condition. On the top of the jar is a piece of iron trellis, and on that trellis is placed some charcoal. If any one who is curious will try to smell the partridge through the charcoal he will utterly fail to detect any odour; but not only are the offensive emanations given off from the partridge—the sulphuretted hydrogen and ammonia—wholly absorbed by the charcoal, but it also absorbs the oxygen gas from the air, and these gases—the oxygen of the air, the sulphuretted hydrogen, and ammonia—at once react upon one another. The gases arising from the partridge become burned or destroyed through the presence of the oxygen, and accordingly this action would go on for any length of time. Now, for the accommodation of any one who is still curious, there is an opening closed with a cork in the side of the jar underneath the charcoal, and if he wishes to ascertain the difference between the gases before they pass through the charcoal and after they have done so there is an opportunity for him to gratify his curiosity.

The same kind of action which enables charcoal to behave so excellently as a purifying substance, also renders it valuable as a decolourising agent. Here we have two columns of charcoal—the charcoal obtained from bone—and I want to call your attention to the decolourising effect it will produce. We have here two coloured liquids which we will pass through these columns of charcoal, and in order that you may see what change takes place, we will take two glasses of each liquid, and reserve one glass of each to enable you to see what change is produced in the liquids by their passage through the charcoal. One of these liquids is blue indigo, and the other cochineal. We will now pour one glass of each slowly through the charcoal, for the decolourising action is one which, like the absorption of the ammonia gas, takes a little time for its accomplishment. The result will be, either that the colour will entirely go, or will be diminished to such a degree that you will see a very great difference in the appearance of the liquids as they run out of the charcoal. [The filtered liquids, after passing through the charcoal, were exhibited to the audience, and found to be deprived of their colour by the filtration.]

Now, in the minute or two that remains to me I will direct your attention to the use of charcoal in charcoal filters. You see on the table two glasses of water; one of these is the water supplied to this Institution. This is, perhaps, hardly a fair sample, because, after these heavy rains, it is far more impure than usual. Here is some of the same water after it has passed through this filter, which is filled with animal charcoal, much in the same way as those in which we filtered the coloured liquids. Here are specimens of filtered and unfiltered water, and they are so placed that you can see with one eye through each tube at the same time.

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

Changes of charcoal itself, as distinguished from changes brought about by charcoal—Its little liability to change under ordinary circumstances—Its susceptibility to action of strong chemical agents—Change of charcoal into carbonic gas by its combustion or burning—Combustion of charcoal set up at very moderate temperatures—Its

slow or rapid combustion in air according to circumstances—Its brilliant combustion in oxygen—Properties of resulting carbonic gas—Its usual production from chalk or marble—Its combination with lime to reproduce chalk—Its power of extinguishing flame—Its solubility in an equal measure of water—Its increase of solubility in water by increase of pressure—Effervescent waters made by saturating different waters with carbonic gas under pressure—Effervescence due to escape of excess of carbonic gas on removal of pressure—Residuary carbonic gas expelled on boiling the water—Solubility of chalk in water saturated with carbonic gas—Occurrence of so-called dissolved chalk in most natural waters—Its deposition as boiler-fur on boiling such waters—Carbonic gas, or fixed air, one and a half times as heavy as common atmospheric air—Various illustrations of its heaviness—Its capability of being poured through air, as a heavy liquid may be poured through a light one—Its outflow through a tap, transference through a syphon, falling out by a cup, &c.—Floating of air on carbonic gas, as of spirit on water—Gradual mixing of air with carbonic gas, and their non-separation after admixture.

You will remember that ordinary atmospheric air is a mixture of two different kinds formerly called vital and non-vital air,—or rather, instead of saying "non-vital," chemists used the word *azotic*, derived from the Greek. Vital air is now called *oxygen*, and the azotic is called *nitrogen*. When bodies burn in air they combine with the oxygen of the air, or, in other words, become oxidised, so that when you say a body is burnt in air, it is almost the same thing as saying that it is oxidised, for the fact of its being burnt implies that it becomes oxidised. Now, all the ordinary substances which we are in the habit of burning for the sake of getting either light or heat, consist substantially of carbon and hydrogen, though these do not form their exclusive constituents, as they frequently contain other elements as well. The carbon and hydrogen are in an unburnt or substantially unoxidised condition. This candle, for example, although it is perfectly white, contains a very large amount of carbon, and there is nothing more remarkable in the white candle containing carbon than there is in the white marble containing it. The only point of difference is, that in the marble the carbon is already oxidised or burnt, and in the candle it is not. When we light a candle we oxidise or burn its carbon, and we get its oxidised hydrogen in the form of water, and its oxidised carbon in the form of carbonic gas. When a candle is burnt with a sufficient amount of air, so as thoroughly to burn its constituents, we get nothing but these two products. Here is a bottle in which a candle has burned; the sides of the vessel are covered with moisture which has been formed in the burning, and on pouring some lime-water into the bottle, and shaking it up, it is converted into a mixture of chalk and water, by the carbonic gas which has been formed in the bottle by the combustion of the carbon of the candle. When, however, there is not enough air or oxygen to combine with both the carbon and the hydrogen of the burning candle, one of them must, in familiar language, "go to the wall," and it is the carbon which does so. The hydrogen is burnt first, the oxygen having a preference for it, and the candle deposits its carbon in the form of soot. Now, this is an illustration of the way in which nearly all the varieties of charcoal are made. The materials are burnt with an insufficient supply of air—enough to burn the hydrogen and not the carbon—and accordingly the carbon is deposited. Those large masses of coke which you see behind the locomotive engines are obtained in a similar manner. The coke consists of the carbon of the coal, the hydrogen being burnt away in the process of manufacture. In the same way, charcoal is got from wood by burning off the hydrogen and leaving the carbon unburnt; but there is altogether a different method by which the carbon may be separated from the hydrogen, and I mentioned it in my last lecture. Coal gas, you know, although perfectly transparent, contains black carbon, and when this coal gas is burnt with an insufficient supply of air we get soot by our old process (I call it *old* because of my having already spoken of it); but if, instead of burning the coal gas in that way, we make it very hot, under such circumstances that, through the exclusion of air, neither the carbon nor the hydrogen gets burnt, these constituents are separated from each other. Here is the tube containing the white porcelain, which, during the last lecture, we subjected to a strong heat while the coal gas was passing

through it. The blackening of this white porcelain indicates that the carbon of the coal gas has been separated from the hydrogen, and the separation occurred, in this case, not from the effect of imperfect burning, but through the application of a strong heat. This, then, is another mode in which carbon may be obtained from its combinations. That large piece of carbon in front of you is called *gas carbon*, and it was made in the same way as that in the tube—by subjecting ordinary coal gas to a sufficiently high temperature. That carbon ought to have remained in the coal gas, but it was separated from it, and lined the interior of the vessel when the hydrogen passed on and left it.

Having spoken of the different ways in which carbon may be separated, I will just call your attention to an experiment which shows the actual production of it. I have here a small platinum dish, in which I have placed some substances capable of being burnt; these are nothing but nuts, kernels of fruit, acorns, and so on. If I simply burn them, they will all go away, and nothing will be left of them; but if, before making them hot in the dish, I take the precaution to cover them with sand, so that they get a very small supply of air, then they will burn imperfectly, and at the end of the lecture we shall have a residue in the form of charcoal. I am applying a good strong heat, and, in a little while, the hydrogen gas will escape from the top of the sand, and there ignite. You will see the hydrogen and a portion of the carbon burning, but the great mass of the carbon will remain behind, and we shall find it at the close of the lecture much in the same form as you see these nuts and kernels in this glass, converted into charcoal. [Later in the lecture the hydrogen driven off by the heat from the contents of the platinum dish was observed to be burning on the surface of the sand.]

So much for the way in which carbon is obtained; now for its properties. You will recollect that in the last lecture I called your attention to its very remarkable effects in absorbing gas. When you take a piece of charcoal into your hand, you not only have the carbon there, but you have also a large quantity of air or gas condensed in the pores of that carbon. In our last lecture, by means of an experiment with the air-pump, I showed you the charcoal giving up the air which had been contained in its pores. That was an illustration of the mode of extracting the air from the charcoal. Now I want to show you the way in which we can get air *into* the charcoal. In this case, the air we will take is ammonia. I performed the experiment during the last lecture, and I will now repeat it. You see that the charcoal is gradually absorbing the ammonia gas, and, as it does so, the mercury rapidly rises.

There are some other curious properties of this charcoal to which I briefly alluded in my last lecture, and about which I wish now to make some further remarks. You will recollect my telling you that the gases given off by the partridge, undergoing the change called putrefaction, are absorbed into the charcoal, but they are something more than absorbed—they are *destroyed*. They are slowly burnt or oxidised—for you will remember that burning is another word for oxidation. The charcoal absorbs not only the gases given off by the partridge, but also these atmospheric gases, and when these come into contact with the gases given off by the partridge, which are, particularly, sulphuretted hydrogen and ammonia, they destroy them by oxidation. Now, this sulphuretted hydrogen gas which is emitted by putrefaction, has an exceedingly objectionable smell, and this smell affords one of the most delicate means of recognising its presence; but, fortunately, there are other ways of detecting it. It has the property of affecting certain metals, and when we want to ascertain whether this gas is present, we are not obliged to resort to the unpleasant method of smelling it. In this glass jar I have some paper which has been prepared with a metallic solution, and I will cause a current of sulphuretted hydrogen gas to pass through the tube into the jar or cylinder, and you will notice, I think, in the course of a little while,

that our test paper inside the cylinder indicates to us the presence of the gas, just as effectively as its smell would do, if we put our noses to the vessel. You see that the letters gradually come out on the test paper; they have now become perfectly visible. Thus we are able to recognise this gas, not only by its smell, but by its action on the paper. I have here a tube which brings me a current of ordinary air, worked from a bellows below. This current bubbles up through a solution containing sulphuretted hydrogen, and, in so doing, it takes some of the sulphuretted hydrogen with it; it then goes into this glass vessel, when the sulphuretted hydrogen affects our test paper, and the air escapes from the top of the jar. If it escaped direct into the theatre, the sulphuretted hydrogen would be smelt by you; but I place over the top of the jar some pieces of wood charcoal, which absorb the sulphuretted hydrogen, and destroy its smell. We will now try the action of this gas on another kind of test paper, and here the effects will be somewhat similar to those produced in the last experiment, only, in this case, I have no letters written upon the paper. We will pass the gas through this other cylinder containing test paper, and you will see what effect it has there. In this case, the paper, instead of being written over with letters formed by a test solution, has been steeped in different solutions, and accordingly a very much larger quantity of gas is necessary to colour the whole of the surface. You see the paper is now becoming coloured; first we have the action of the gas upon a salt of lead, as shown by the production of a black mark. As the gas rises higher and higher, you see it begins to effect the next solution on the paper, and in this case, instead of a black stain, we get an orange one, and I dare say, after a little while, another colour will be developed at the top. I may call your attention to the bottom of the paper becoming yellow. The colour at the top is now appearing, and at the risk even of getting a slight smell from unabsorbed sulphuretted hydrogen, we will allow the action to go on to the full extent.

I want now to illustrate to you the mode in which charcoal arrests the flow of this gas, and for this purpose I will here take some small glass cylinders, containing metallic solutions upon which sulphuretted hydrogen will act, and I am going to blow through these solutions the same kind of sulphuretted air that I blew into these larger cylinders a few minutes ago; but I will arrange the experiment in such a way that before the air bubbles up into the water, I can either let it pass through the charcoal or not, at will. I am afraid that in this case I cannot keep back the odour, but I will endeavour to do so as much as I can. Here is one pair of cylinders, and the gas which passes through them must, first of all, go through the charcoal; but in order to pass through the other pair of cylinders it need not do so. We will first of all let it go through these cylinders where there is no charcoal, and then see what are its effects. The gas now enters our solutions, and immediately produces, in the one case, a purple colouration, and, in the other, a decided orange. This is caused by the gas itself, before it has gone through the charcoal. Now we will let it come up from the other cylinders; in this case, it has first of all to go through the charcoal. Now you see that after it has gone through the charcoal it has no action whatever upon the solutions. It is now bubbling up through these solutions in the same way as it did through the others, but here we get no action. The charcoal completely arrests the passage of the gas—not only arrests it in the way of absorbing it, but entirely destroys it. In this instance, we are passing the two gases, sulphuretted hydrogen and oxygen, into the charcoal, and these immediately react upon one another in the pores of the charcoal. In order to show you that the want of effect does not arise from any exhaustion of our sulphuretted material, we will now let it ascend through these new vessels, without passing through the charcoal, and you see that the solution on my left very quickly becomes orange in colour, and that on my right

becomes purple. Thus, the want of action was not due to a deficient supply of sulphuretted gas, but it was merely owing to the fact that, as the gas passed through this tube containing charcoal, it was so completely absorbed and oxidised that it could not, in any way, affect the solution through which it afterwards bubbled.

With regard to the action of charcoal upon liquids, you will remember that, on the last occasion, we had two long columns through which we filtered a red and a blue liquid, both of which had their colours completely taken out. I ought to call your attention to some of the practical applications of this property of charcoal. Here are some specimens of Madeira, Demarara, and beet-root sugar, which have been kindly supplied to me by Mr. Duncan, of Whitechapel. The whole of the colour of these liquids has been taken out by filtering them through charcoal, in the way that you saw me filter the liquids the other day. After the first filtration, you get a liquid which has a distinctly brown tinge when compared with the white sugar, but after a second filtration through charcoal the liquid, on evaporation, yields pure white sugar.

Now, in all those changes to which I have called your attention, the charcoal itself remains the same. We have next to consider more distinctly the changes which charcoal undergoes, apart from those which it is capable of producing upon other bodies.

Charcoal is a very stable body. It lasts for ages and ages, and is not liable to decay. In the British Museum there are specimens of charcoal which were charred at Pompeii, and which have stood for centuries. It is one of the most stable bodies we know; nevertheless, it is capable of being acted upon by strong chemical re-agents. I will take some of this substance, and act upon it by an acid. I must have my charcoal rather warm for this purpose, and now I let it fall into this strong chemical agent—nitric acid—and you see that, under these circumstances, the nitric acid acts upon the charcoal very violently. The charcoal, which is a very permanent body, and not affected by most chemical agents at ordinary temperatures, is acted upon by this nitric acid, and to such an extent that it not unfrequently takes fire, as in this experiment.

The most important, however, of the changes which it is capable of undergoing, is one to which I have already, on one or two occasions, directed your attention, namely, its change into carbonic gas, and now I am going once more to show you this change, but in a somewhat different form. I have here a piece of easily igniting charcoal inclosed in this tube; I just set fire to it at one end, and place it alight in the tube, through which I pass a current of oxygen gas. You observe that the charcoal is now burning with very great brilliancy in the oxygen gas. The charcoal is converted into a gas, and as it bubbles up through our lime-water it changes the lime-water into a mixture of chalk and water. In this way I cause the complete disappearance of the charcoal, it being converted entirely into the carbonic gas, which I am arresting by means of the lime-water. Here you see the large amount of chalk which I have produced by the conversion of our charcoal into carbonic gas, and the combination of that carbonic gas with the lime contained in the lime-water.

Now I will illustrate the conversion of charcoal into carbonic gas in one or two other ways. I will bring before you another mode by which we may burn this substance in oxygen. You observe I am burning some in a globe full of this gas, and it is ceasing to be charcoal, and is being changed into carbonic gas; and here you have an illustration of the most remarkable, or, at any rate, the most important of the changes which charcoal is capable of undergoing. Lastly, I will show you one more experiment illustrating the mode in which we can burn charcoal in oxygen. [A stream of oxygen was made to impinge upon some pieces of incandescent charcoal lying at the bottom of a glass beaker.] You see the very brilliant manner in which the charcoal burns in our current of oxygen gas.

We have, then, arrived at this point—that charcoal is a substance which burns very readily, and, by its combustion, is converted into carbonic gas.

Having considered the properties of charcoal somewhat minutely, I will next examine more particularly a substance to which I have already made very frequent reference, namely, carbonic gas, which is the product of the burning or oxidation of charcoal. What, then, are the properties of this carbonic gas?

First of all, with regard to the mode in which it is made. You will remember I made it just now by burning charcoal. That is one way; but another way is by starting, not from charcoal, but from marble. If we take some marble and heat it very strongly, it gives off this carbonic gas; but instead of acting upon it by heat we more commonly, as a matter of convenience, treat it with acids, and consequently we employ an apparatus of the kind which you have seen used for that purpose at previous lectures. Here I have such an apparatus, in which carbonic gas is being produced from marble, and from which I can obtain it in order to consider its properties minutely and *seriatim*. I first turn on our gas, and immediately we recognise one of its characters, namely, that it has the property of combining with soluble lime, and of converting it into insoluble chalk. The next property of the gas which I shall show you is also one to which I have before alluded—its property of extinguishing flame. Here is a large glass jar which has been filled with carbonic gas from an apparatus beneath this theatre, similar to the one on the table, but which is on a larger scale, and supplies us more conveniently with the gas. We will see whether this glass jar is full of the gas. [A lighted taper was extinguished immediately upon being introduced within the brim of the jar.] Yes, it is quite filled. You see, directly I put the taper in it is extinguished. If I take some larger substance than this—this burning tow, for instance—it also is completely extinguished. The second property of carbonic gas, then, is that of putting out flame.

I wish now to make you acquainted with some further properties of this gas, so I will first show you what its behaviour is under certain circumstances, and then I can remark upon it after you have seen the experiments. Here is a long tube filled with water, and having its open end immersed in the same fluid. I will raise the mouth of the tube a little, and fill it to the label with carbonic gas; I take the tube and shake it up with the water, and then notice whether any effect is observable. I keep it closed firmly with my hand, and replace the mouth in water; on removing my hand you see that the liquid rises very considerably in the tube. This experiment, then, reveals to us the fact that carbonic gas is capable of being absorbed in water. It dissolves appreciably in water through this agitation, but it will dissolve to a much greater extent under pressure. The experiment is rather too long to allow me to show it to you as a lecture experiment, but I will point out to you its result. If I took a bottle of ordinary water, and applied this forcing syringe to it, I could inject into that water a large quantity of carbonic gas—a quantity, indeed, only limited by the strength of the bottle. I could go on forcing in the gas until I burst the bottle. Here is a bottle of soda-water which I have made by pumping carbonic gas into ordinary water, and, in fact, most of the soda-water ordinarily met with is made in this way. On removing the pressure from the surface of the liquid, the gas escapes, and this gas which is given off is nothing more than that which is obtained from marble or burning charcoal, and it has all the properties which I have mentioned as belonging to carbonic gas. You will remember that the gas from marble has the property of extinguishing flame and of making lime-water turbid. I will collect some of the gas evolved from soda-water, and I will then show you its properties. Here, for example, is a bottle of soda-water; I open it in the usual way, but cautiously, so that the gas may not escape very violently. Having removed the cork, I let the gas from the soda-water play upon the flame of a candle, and you see it at once puts it out. Now let me show you the

amount of gas which we can collect from a bottle of soda-water. I take a cylinder of water, close it with a glass plate, and invert it in a pneumatic trough. Here is a bottle of soda-water, into which I have inserted a tap; this I turn on, and allow the escaping carbonic gas to pass through a tube and bubble up through the water into the glass cylinder, and in this way I can collect a considerable quantity of this gas. Now, let me show you that this soda-water gas is capable of giving a precipitate with lime-water. I take another bottle of it, but instead of using a screw-tap, which is not necessary for the present experiment, I remove the cork in the ordinary way, and quickly insert in its stead a cork fitted with a glass tube, which has been placed in a hole bored through the cork. The gas which escapes from the liquid in the bottle passes through this tube, and we now have the gas bubbling up through the lime-water test, and converting it into chalk and water, just as did the gas we obtained in other ways.

This gas has another very important property; instead of using the ordinary strong lime-water, I will take some far more dilute. I have put some of the strong lime-water into this jar, and now I will add to it a considerable quantity of distilled water. Here, then, is our diluted lime-water, and I now pass a current of carbonic gas rather quickly through this apparatus. The first effect in this case, as on previous occasions, is, that we get our deposit of chalk; but I want you to watch the experiment, for you will find that the chalk, which at first is apparent, entirely disappears after a little time. I can show you the same result in the case of soda-water. I will pour some lime-water into another of these glasses, and then empty into it a bottle of soda-water, and watch the result. You observe that the first effect is that the lime is converted into chalk, of which we obtain a considerable amount. Now I will add some more soda-water, and you will observe that the liquid becomes perfectly clear. Here, again, is another liquid in which chalk has been formed by the action of carbonic gas upon lime-water. It is perfectly opaque, but if we add a little soda-water to it, the precipitate of chalk will eventually disappear. We have thus learned a fact entirely new to us, namely, that, although, when we add carbonic gas to lime-water, we get insoluble chalk, yet if we continue to pass the carbonic gas through the chalky liquid, the whole of that chalk entirely dissolves after a certain length of time; so while chalk is insoluble in pure water, it is perfectly soluble in water containing carbonic gas. Indeed, all our ordinary waters hold chalk in solution, held dissolved by means of the gas obtainable from charcoal.

Another fact with regard to the solubility of this gas in water is that, when we remove the pressure—that is to say, take the cork out of the soda-water bottle—we allow the escape of a considerable quantity of this gas, but we do not expel the whole of it. In order to do this, we shall find it advisable to boil the water. In this flask we will boil some water containing carbonic gas. This is a bottle of soda-water from which we allowed all the gas to escape which would do so upon merely uncorking the bottle, and as the escape has gone on to that point, we will allow the water to boil in the flask, or rather we will apply heat to it, and you will find that the heat will drive off more of the gas, which, in the course of a minute or two, we shall have collected in a cylinder. I will allow it to heat rather rapidly, and you will see the gas bubbling up through the cylinder. You observe we are now driving off more of the gas by the application of heat. Now, just bear in mind what would happen if I took the cylinder and boiled the liquid containing the chalk, which was dissolved by the presence of carbonic gas in the water. The heat would drive off the excess of carbonic gas, just as we are forcing the carbonic gas off from the liquid in the flask. We ought, consequently, to have our precipitate of chalk manifesting itself in the solution; this is just what happens. We will boil that liquid, and you will see that when this is done it will deposit chalk on giving up its carbonic gas. [After an interval]—I will now ask you again to observe this liquid. You remember

it was at first perfectly clear, but on boiling it has become opaque. The chalk which was held in solution by the carbonic gas has been precipitated as the gas became driven off by the heat. That deposit is nothing but boiler fur. Now, this [exhibiting a large broken kettle considerably furred inside] is not a very elegant article to bring before a Royal Institution audience; this kettle contains a large quantity of fur, consisting of the chalk which was dissolved in the water by the carbonic gas, and deposited on the inner surface of the kettle, when the carbonic gas was driven from the water by boiling. Chemically, this deposit is nothing more than marble. If I take a portion of this boiler fur and act upon it by heat, carbonic gas will be evolved, or, if I add acid, it effervesces very readily, and gives rise to the same gas.

We have now collected a rather large quantity of gas by boiling the soda-water. We will just ascertain whether this gas possesses the property of extinguishing flame. [A light was lowered into the jar containing the collected gas.] You see from this experiment that it *does*; thus, partly by merely removing the cork of the soda-water bottle, and collecting the escaping gas, partly by boiling the liquid, you see that we have procured a large quantity of carbonic gas, of which I will now exhibit to you some other remarkable properties. I have here a bottle containing gas; I take out the stopper, and still we have the bottle of gas. I will test its presence in the usual way, by introducing a lighted taper; the taper is at once extinguished, and though the bottle might be left open for a considerable length of time, still the gas would remain and the taper would be put out. Now, what does that suggest to us? Let me try whether I can perform a somewhat similar experiment with a glass of water. I will take this bottle containing a solution of salt. It is nothing more than common salt dissolved in water, and it is coloured so as to make it visible. Now I lower this bottle into a jar of colourless water: I do it carefully, so that the solution of salt mixes with the water as little as possible, and you see that the coloured solution of salt remains in the bottle, although it is at the bottom of the jar of water. It does not mix with the water to any appreciable extent, because the solution of salt is really heavier than the water above it; and just in the same way this carbonic gas remains in the open bottle, undergoing no very appreciable amount of mixing with the surrounding air, because it is really heavier than the air. I once more introduce the taper, and you see that the bottle still contains the gas, for the taper is extinguished. Now I will reverse the experiment, and take this glass bottle, containing a liquid lighter than water—spirit of wine—coloured red. I will lower it into the jar of water just as I introduced the solution of salt; but observe the difference of the result! See how the red liquid is streaming up to the top of the jar of water, and the colourless water is pouring into the glass which contained the spirit. Our carbonic gas is, therefore, in the position of this solution of salt, and not in that of the spirit of wine. You see that, introducing in this way the coloured spirit into the jar of water, I obtain two perfectly distinct layers of liquid. The water is beneath, and the coloured spirit at the top; you see I can draw off some of the latter from the upper part of the vessel.

I can show you some very curious effects of the weight of this carbonic gas, and I have here an experiment arranged for that purpose. In this bottle are two separate gases—carbonic gas and oxygen—the oxygen being in the upper part. I pass this lighted taper rapidly through the oxygen into the carbonic gas, and the flame is immediately extinguished. I raise it into the oxygen, and you see how readily the taper bursts into a flame and how brilliantly it burns. Thus, you perceive that this carbonic gas is not only heavier than atmospheric air, but it is also heavier than oxygen, which will float on it. [The taper was extinguished and rekindled several times in succession by being plunged into the carbonic gas, and then rapidly raised into the stratum of oxygen in the upper part of the bottle.]

Now I will make use of some liquids to illustrate to you the effects of these differences of weight. In this jar I have

merely some water coloured red in order that it may be distinct, and through this water I want to pour a heavy liquid, namely, a solution of common salt, coloured purple, and by pouring this carefully through the funnel, I shall, in a little while, get a layer of purple liquid at the bottom. There is always a certain amount of mixing, but it will be so little that you will easily recognise the two distinct layers—a purple layer of solution of common salt at the bottom, and a red layer of water at the top. I think those who are near will see that we have already obtained these. I am, in fact, pouring a heavy liquid through a lighter one, and just in the same way I can pour a heavy gas through a lighter one, either by means of a funnel, or by another method which I will presently explain to you. If I take a liquid which is much heavier than water, I can pour it into water and form a distinct layer without any funnel. Here is some colourless water, and into this I am about to pour a liquid which is much heavier than the solution of salt, and which may therefore be poured without the funnel. This heavy liquid is oil of vitriol, and you see that in this way we get the colourless water at the top, and a stream of oil of vitriol descending to the bottom, and there forming a shading of blue.

Now I want to illustrate the same point to you by means of experiments performed with carbonic gas. Here is a cylinder of this gas coloured brown, and I will pour some of it into this cylinder of air. You will see it pass through the funnel and reach the bottom of the cylinder. It takes some little time to descend, but I can already see it pouring down. The funnel is now full of the brown gas, and sufficient has descended into the cylinder to answer our purpose. I have thus poured down our heavy carbonic gas, which was coloured brown; but I will now show you that I can not only pour carbonic gas through the funnel, but through the air without a funnel, just as I did the oil of vitriol through the water. I take this bottle of carbonic gas, and let a little of it flow upon the candle, and so put it out. Now I will pour some into this bottle containing lime-water. You observe that the lime-water is perfectly clear; but I now remove the stopper from the bottle of gas, and pour some of it upon the lime-water, and you see that we get an ample amount of gas. Let us try the weight of the gas in another way. Here is a pair of scales; you see that, at present, the counterpoise is a little too heavy, and goes down rather lower than the other side of the balance. I now open the bottle of gas and pour some of it carefully into the beaker attached to the scales, and the gas is so heavy that it actually turns the balance, and not only turns it, but keeps it down to a very considerable degree.

I will reserve for my next lecture some further illustrations of the extreme weight of carbonic gas.

FOREIGN SCIENCE.

PARIS, FEB. 10TH, 1869.

Patent for Murexide.—Topaz Deposit.—Electro-capillary Actions.—Proximate Constituents of Cotton Fibre.—Action of the Electric Spark on Marsh Gas.

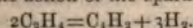
A PATENT has been granted to MM. Kessler and Luxe for the preparation of uric acid, and the products employed in dyeing. Murexide is prepared according to two methods by the authors. In the first process, to a mixture of equal parts of commercial nitric acid and water, small portions of uric acid are added from time to time. At each addition, an action is manifest, and when too much uric acid is present, at once the temperature rises, and binoxide of nitrogen is disengaged. However, towards the finish, there is no fear of the liquid becoming too hot; on the contrary, it becomes necessary to aid the reaction by gentle heating, in order to dissolve all the uric acid possible. The more or less brown liquid thus obtained is filtered, and mixed in the cold with about an equal weight of ammonia. A red colouration and turbidity are caused; by the heat of a water bath abundantly

crystals of murexide are deposited, and the mother liquor, by evaporation, yields a reddish brown dry mass. In the second process the authors act on solutions of alloxan with ammonia salts of reducing acids, giving the preference to formiate of ammonia; the operation succeeds, likewise, with oxalate, but not so well with acetate. It is better to use rather concentrated solutions of the two bodies and to employ heat. The ammoniacal salt is added so long as the liquid separated by cooling from murexide, and thereby decolourised, becomes coloured by the addition of a trace of the ammoniacal salt.

In a very difficultly accessible cave in the mountain of Galenstock, which separates the canton of Berne from that of Uri, a very rich deposit of topaz has been recently found, valued at more than 100,000 francs.

M. Becquerel, in his sixth memoir "On Electro-Capillary Actions," describes the processes which he employed to obtain a great number of hydrated oxides in the crystalline state. In a vessel containing a solution of nitrate of copper, a smaller vessel, one side of which was composed of parchment paper, was placed, containing aluminate of potash. Nitrate of potash was produced, but in the place of aluminate of copper, in the porous vessel crystals of hydrated alumina presented themselves, and on the outside crystals of hydrated oxide of copper formed. By replacing the aluminate of potash by silicates, M. Becquerel obtained hydrated silica sufficiently hard to scratch glass.

M. Berthelot has examined the action of the electric spark on marsh gas. When a succession of powerful sparks is made to traverse pure marsh gas, carbon is deposited and the volume of gas augments considerably. Operating with 100 c.c., this volume becomes 127 c.c. at the end of two minutes, 154 c.c. at the end of ten minutes, and so on; but some hours are required for the complete destruction of the marsh gas. That no marsh gas remains at the end of the experiment may be demonstrated, after removing the acetylene and the traces of condensed vapours which are present mixed with hydrogen. According to received theories, the volume of marsh gas should become double, since it is resolved into hydrogen and carbon:— $C_2H_4 = C_2 + 2H_2$. The experiment does not agree with these theories, 100 volumes of marsh gas furnishing only 181 volumes in two concordant determinations. Acetylene constitutes 13.5 to 14 per cent of the products; the half of the marsh gas is transformed into acetylene by the action of the spark:—



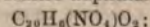
At the commencement of the experiment the acetylene formed corresponds to an almost complete transformation of the marsh gas, but the proportion of acetylene formed from the marsh gas is smaller in proportion to the amount of acetylene present. Therefore, by arresting the experiment for a few minutes, and absorbing the acetylene, it should be possible to push the action further. M. Berthelot has been able in this way to form 39 volumes of acetylene from 100 volumes of marsh gas; these figures show that four-fifths of the marsh gas was converted into acetylene. The conversion of marsh gas into acetylene does not explain directly why the volume of gas is not doubled under the influence of the spark. In fact, the formation of acetylene, as well as carbon, corresponds to a double volume; but acetylene under the influence of heat passes into condensed hydrocarbons. Thus, it is easy to detect the presence of triacetylene or benzol vapour in the gaseous products of the reaction, by agitating with fuming nitric acid. By reason of these condensations, a part of the hydrogen remains combined in the heavy vapours or fixed compounds, thus diminishing the volume of free hydrogen. Half of the marsh gas is converted into acetylene, 3-8ths into condensed hydrocarbons, and 1-8th simply into carbon and hydrogen. These results point to a similarity in the action of the spark and that of heat. The prolonged action of a dull red heat ends in nearly the whole of the acetylene being condensed, even in the presence of a large excess of hydrogen. The electric spark, however, only acts on the acetylene when pure, or mixed with less than six times its volume of hydrogen.

PARIS, FEB. 24TH, 1869.

Lead v. Tin for Water Pipes.—Naphthaline Yellow.—Cholesterine in Wheat, Rye, and Barley.—Determination of the Density of Ozone.—Varnish for Iron.—Sulphate of Aniline a Test for Nitric Acid.

PUBLIC attention has often been directed to the dangers attending the use of lead pipes for the distribution of water. It is quite certain that some waters do dissolve traces of lead. The water obtained on board ships by the distillation of sea-water has been observed to contain lead when a worm of this metal has been used in its condensation. A description of a pipe invented by M. Hamon promises to obviate the chance of this contamination. M. Hamon makes use of a leaden pipe covered with tin; the covering of tin is not obtained by merely fusing tin on the surface of the lead, but by the simultaneous drawing out of two concentric cylinders of lead and tin. This operation is made by means of a hydraulic press under an enormous pressure, and the result is a homogeneous, compact, and unalterable material, which it would be impossible to obtain by other means. Pipes of this description are also far preferable to lead pipes for the conveyance of gas in houses. The ingenious invention of M. Hamon has been the object of several favourable reports from the Council of Public Health for the Seine, the Academic Society of Nanterre, the Director of Naval Architecture, and several engineers.

M. Martins has published a note on the dye which is prepared with hydrochlorate of naphthylamine and nitrite of potash, and passes by the names of golden yellow and Manchester yellow. Some have considered this compound as dinitronaphthol or binitro-naphthalic alcohol—



others consider it nitroso-naphthaline; others, again, consider it dinitronaphthol, $C_{10}H_6N$. Whatever the colouring matter may be, it possesses a considerable colouring power, and is fixed without any mordant on silk and cotton. In commerce, calcium or sodium are commonly combined with the colouring matter. It crystallizes in little yellow needles, and behaves like a powerful acid; it may be purified by dissolving in ammonia and crystallizing, and afterwards precipitating by a concentrated solution of chloride of ammonium. Boiling water scarcely dissolves a trace of the yellow colouring matter, which is only slightly soluble in alcohol, ether, and benzol. It decomposes carbonates, and gives, by double decomposition, salts which, in general, possess a yellow or orange colour; this colour is the ammonia salt, which crystallises in needles containing an equal quantity of water of crystallisation. Treated with tin and hydrochloric acid, this colouring matter gives a compound which the author considers as an isomer of alizarine.

The presence of cholesterine in wheat and rye has been observed by M. Ritthausen, and in barley by M. Lintner; the following process is described by the former:—The fatty matter obtained by the extraction with ether or hot alcohol is treated with a little ether to render the olein fluid, which is separated by filtering. The filter is drained, then washed with warm alcohol, which leaves a colourless residue; after boiling with a soda lye of 25 per cent the residue is melted, washed with warm water, and dissolved in ether, which, after cooling, deposits plates of cholesterine. This proximate constituent possesses the following reactions:—Heated with sulphuric acid, or hydrochloric acid and sesquichloride of iron, it turns blue; it reddens when, after evaporation to dryness with nitric acid, ammonia is added; finally, after prolonged contact with sulphuric acid and chloroform, the solution becomes blue-violet tinted. Palmitine is the fatty matter of rye, that of barley is laurine mixed with a fatty principle intermediate between myristine and palmitine. Bran contains 3.5 per cent of fatty matter, while flour only contains 1 per cent.

M. Soret has made a determination of the density of ozone. Former experiments proved ozone to be an allotropic condition of oxygen, and to be denser than ordinary oxygen.

When ozone is treated with oil of turpentine or oil of cinnamon, the diminution of volume is double the increase of volume which results when ozone is destroyed by heat. The conclusion to be drawn from this fact is, that the density of ozone is one-and-a-half times that of oxygen; other experiments tend to confirm this result. The rapidity with which ozone diffuses is considerably greater than that of chlorine, and very close (though a little feebler) to carbonic acid. M. Soret adopts 1.658 for the density of ozone.

Dr. Lunge has published a paper on "The Preparation of Varnishes for Iron as Secondary Products in the Distillation of Coal Tar." Varnishes of this description are very easily prepared by melting pitch with different matters obtained in the distillation. No substances other than those obtained in the distillation of tar are required, and all that is necessary in the manufacture is an iron vessel in a covered building. The form of vessel most convenient is a vertical cylinder slightly concave at the bottom. About as much pitch as would be contained in a three-quart vessel is thrown in at a time, and a small quantity of oil added to facilitate the fusion of the pitch and to prevent its solidifying on cooling. Considerable heat is then applied, and small quantities of oil added from time to time; before adding the whole of the oil, it is important that the melted mass should be allowed to cool sufficiently that the oil will not enter into ebullition. Exact proportions can be of no service, as different degrees of consistence are required for different purposes. Samples are withdrawn from time to time and allowed to become quite cool to judge of the consistence of the material. The oil employed is the heavy oil of tar, and for ordinary kinds of paint for metal, pitch is melted with it as previously described. But for many purposes, a simpler process still may be made use of, especially in the manufacture of large quantities. Tar is placed in small retorts (the ordinary retorts are too large for the purpose), and heated until the heavy oil commences to distil over; then the fire is diminished, and the retort allowed to cool somewhat; the retort is then opened, a certain quantity of heavy oil added, and the mixture well stirred; all that remains to be done is to pour the mixture out, and the operation is finished. Varnish made in this way is preferable to tar, and dries sooner; according to the state of the atmosphere it dries in twenty-four or forty-eight hours. By incorporating naphtha of the lowest quality—to do which the mass must still be warm—with the material made with light oil instead of heavy oil, a varnish may be obtained which will dry in an hour or less.

Sulphate of aniline, in the hands of M. Braun, has become an exceedingly delicate test for nitric acid. In a test glass about 1 c.c. of pure concentrated sulphuric acid is placed (1.84 density); to this is added, drop by drop, $\frac{1}{2}$ c.c. of a solution of sulphate of aniline, prepared by adding 10 drops of aniline of commerce to 50 c.c. of sulphuric acid diluted in the proportion of 1 to 6. A glass rod is dipped into the liquid to be tested, and then into the mixture in the test glass. On moving the stirrer about gently, when the slightest trace of nitric acid is present, red streaks mark the course of the glass rod. Upon the least increase of the amount of nitric acid, the liquid becomes carmine tinted, and the addition of one drop of dilute nitric acid causes the liquid to become a deep red tint in the first case, and then reddish brown. This reaction enables the presence of nitric acid to be detected in commercial sulphuric acid. The author has also observed small quantities of nitric acid in well waters, and the same reaction has shown, most plainly, nitric acid in rain water after a storm. Hyponitric acid produces the same reaction as nitric acid, sharing in this fact the same defect as most of the other processes employed for detecting nitric acid.

REPORTS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

The second general meeting was held in the rooms of the Literary and Philosophical Society, on January 28th, and

was numerously attended. In the absence of the President, the chair was occupied by John Glover, Esq.

The names of eight new members were read for the first time.

Mr. JOHN PATTINSON read a note "On the Relation between English and Foreign Alkalimetric and Chlorimetric Degrees."

In the discussion which followed, the general feeling seemed to be that 23 should be substituted for the various incorrect values employed for sodium in some laboratories.

Mr. R. C. CLAPHAM read a paper entitled "Some Account of the Origin of the Soda Trade on the Tyne."

CHEMICAL SOCIETY.

Thursday, February 4, 1869.

DR. WARREN DE LA RUE, F.R.S., President, in the Chair.

AFTER the usual formal business, the PRESIDENT announced that Dr. Wallace, of Glasgow, who had promised a lecture "On the Chemistry of Sugar Refining," had been prevented by illness from attending, but that he had forwarded his diagrams and tables, together with the MS. of his lecture, and that the latter would now be read by the secretary.

Mr. VERNON HARCOURT accordingly proceeded to read the discourse, of which the following is an abstract:—

After a few introductory remarks upon the complexity of the science of chemistry, upon the importance of the technological branches of it to many Fellows of the Society, and upon the encouragement afforded to the study of those branches by the Society, the author draws attention to the statistics of the sugar trade in this country. From the Board of Trade returns for 1868, it appears that 594,656 tons of sugar of all sorts were imported in that year. The duty on this quantity amounted to nearly five and a half millions, and the total money value, including duty, to £21,000,000. At least 400,000 tons were refined in this country. Foreign countries, particularly France, offer very formidable opposition to the English refiners, no less than 34,039 tons in 1868, and 42,047 tons in 1867, of refined sugar having been imported. The author has shown, in a previous discourse,* the unfair terms on which our refiners have to deal with foreign countries. He attributes the present stagnation of the sugar refining trade in London mainly to this unfair competition, but also to the extraordinary development of the industry within the last few years in Greenock and Glasgow. In 1857, the quantity of sugar refined in the Clyde was 38,336 tons, while in 1867 the quantity had risen to 178,013 tons. Last year it amounted to only 171,643 tons, but even this quantity is two-fifths of the whole amount of sugar refined in the United Kingdom. The author believes that the London refiners have been somewhat slow in adopting the most recent improvements introduced in the provincial refineries, and they have been unwilling to give up the making of loaf sugar, which is not now profitable. They work, moreover, under considerable disadvantages in various respects. The refining process here described is that adopted at Greenock for crushed or soft sugar. Its chief peculiarity is that no syrup is produced; all the sugar leaves the refinery in the solid form, and the loss of all kinds only amounts to about 5 per cent.

Sugar Refining.—A proper selection of the raw sugar is a very important point in the refining process. In the Greenock system the raw sugar employed must not contain more than 3 or 4 per cent of uncrystallisable sugar; but where syrup is produced this is of less importance, and concrete and low sugars may be used. Mixtures are often judicious, but on the Greenock system a large proportion of beet sugar is avoided. Several points must be considered in purchasing raw sugar for refining—the proportions of cane and fruit sugar, the amount of extractive, as determining the quantity of animal charcoal required and its deterioration in the pro-

* CHEMICAL NEWS, Dec. 18, 1868. (*Am. Repr.*, Feb., 1869, page 76.)

cess, and the amount of insoluble matter, which, when excessive, is troublesome to wash, must all be taken into account.

The author next gives a table of the composition of twenty samples of raw sugar of different kinds, but remarks that they must not be taken as typical of the various kinds indicated, as they vary extremely in composition.

The French mode of determining the value of a sample of sugar is, upon the whole, a very fair and accurate one. Each percentage of fruit sugar is assumed to prevent the crystallisation of 1 per cent, and each percentage of soluble salts of 5 per cent of cane sugar; thus a sample of Paraiba sugar contained 84.9 of cane sugar, 6 of fruit sugar, and 1.7 of soluble salts; this sample would accordingly yield 70.4 per cent of cane sugar.

First Operation—Solution.—This, which is technically known as “blowing up,” from the fact that open steam was formerly used in it, is effected on the highest floor but one of the building. The blow-ups are cast-iron pans, 4 or 5 feet high and 6 to 10 feet in diameter. The steam is admitted by a heating worm below a false bottom; above and below this false bottom revolving arms keep the liquor in constant motion. Water is introduced into the blow-up, the steam turned on, and the sugar thrown in as quickly as possible from the floor above. In half an hour the filling should be completed, when the liquor should have a specific gravity of about 1.225 (28° Baumé) and a temperature of 180° F. It consists of about two parts of raw sugar to one of water, and a pan of 10 feet diameter will dissolve about 7 or 8 tons of raw sugar. A small amount of flocculent and insoluble matter is removed as scum during the operation. This is the simple process pursued in most of the Clyde refineries; but in others various methods of treatment are adopted to facilitate the purification. Milk of lime is sometimes added to neutralise the small trace of acidity in the raw sugar, and the author thinks this useful, provided that an excess is avoided. The use of blood or albumen was formerly common, but as they render the syrups impure, they are now generally dispensed with. Other reagents have also been used, such as sulphate or phosphate of aluminium or lime, or soluble tricalcic phosphate and lime, but there is great danger of the workmen adding too much of one or another of them, and their use does not appear to be necessary. The dust of animal charcoal has a good effect when quite new, but it cannot be used more than once.

The next operation consists in passing the solution through twilled cotton filter bags in coarse canvas sheaths. These bags are fastened, to the number of 200 or so, to the bottom of a shallow tank, into which the liquor from the blow-up pan is passed. The sides are kept hot by steam.

Decolourising the Syrup.—Animal charcoal has been found by practical experiments to be the most suitable for sugar refining. Many kinds have been tried, some of them much more energetic than it as decolourising agents, but none possess its peculiar combination of valuable qualities. An artificial mixture of clay and some form of carbon has been said to rival animal charcoal, but the author has heard nothing of it lately. Seaweed charcoal approaches most nearly to that of bones, but wants some necessary characters. Sulphurous acid has been tried repeatedly, but it never removes more than three-fourths of the colouring matter, and its liability to change into sulphuric acid renders its use dangerous; for though sulphurous acid does not alter cane sugar, the latter acid does, and even if this is neutralised by lime, the resulting sulphate of lime is injurious to the charcoal, which must subsequently be used. The author has made no experiments on the bleaching action of ozone, but fears that its oxidising action on the sugar would prove troublesome. The carbonisation process used on the Continent is excellent for the juice of the beet, but would not be advantageous in the refining of raw cane sugar. It might be found useful in certain cases, as for instance in purifying the washings of animal charcoal. The author considers that it is an excellent arrangement to have a smaller refinery connected with the larger one for the separate treatment of impure products.

The use of alcohol with a minute portion of hydrochloric or acetic acid, to remove earthy salts before filtration, is next discussed; it has been tried on the large scale in Belgium, but discontinued. Theoretically, it is most advantageous, but its expense would be fatal to its use here, except, perhaps, with duty-free spirit. A moderate-sized sugar house would require about 10,000 gallons of almost absolute alcohol, and this must be redistilled every day. The process has long been used most successfully for testing raw sugars.

Filtration through Charcoal.—The clear liquor is now run into iron tanks filled with animal charcoal, allowed to “settle” for several hours, and drawn off colourless below. At the same time more of the dark liquor is run in at the top, so as to keep the cistern full. When the sugar solution begins to come away yellow, the sugar solution is replaced by the syrup from a previous refine; the whole of the sugar is then washed out with hot water, and the charcoal, after draining, is taken to the kiln to be reburned. The author gives many interesting details as to the size of the cisterns, the size, or “grist” of the charcoal, &c., which our limits compel us to omit. He refers, for a full discussion of the qualities of animal charcoal, to a lecture delivered in Glasgow during last year, and duly recorded in our pages.* In the present discourse he confines himself to the consideration of certain points.

Three analyses of new animal charcoal are first given, the samples containing respectively 9.71, 7.64, and 10.37 of nitrogenous charcoal, in the dry substance. As sold it generally contains about 10 per cent of water. The so-called carbon of animal charcoal contains a notable proportion of nitrogen, and a little hydrogen. The nitrogen is generally about 1-10th of the total carbonaceous matter, but is sometimes considerably more. Old charcoal contains less nitrogen, and the proportion constantly diminishes. The nitrogen appears to be an essential constituent of animal charcoal. Red-hot animal charcoal, quenched with water, evolves ammonia, and the practice ought, therefore, to be avoided. New charcoal always contains traces of ammonia, as well as of sulphides of ammonium and calcium. In a particular case, .011 per cent of ammonia was found; and in another, a sample of charcoal evolved .08 per cent of hydric sulphide when treated with an acid. Both new and old charcoal retains appreciable quantities of gases, which escape when the tanks are filled with liquor, and sometimes explode when a light is brought to the top of the cistern.

Old charcoal should always contain more carbon than new, on account of the carbonisation of the impurities separated from the sugar. If the carbon does not increase with the age of the charcoal, it shows either that air has been admitted during the reburning or that the reburning has been effected at too high a temperature. The increase of carbon in the charcoal is an evil, and should be diminished as far as possible by thorough washing before it is reburnt. The extensive washing has another advantage, for it tends to remove the mineral salts, particularly calcic sulphate, which had been taken up from the sugar. As long as the sugar liquor is strong, calcic sulphate is absorbed and retained by animal charcoal; but when the washings begin, the salt comes away in solution.

Another cause of the deterioration of charcoal is the constant shrinking of its volume, and its consequent diminution in porosity. A ton of new charcoal usually occupies about 50 cubic feet, but this diminishes to 40, and even in one case to 28 cubic feet. This appears to be due to a partial fusion of the calcic phosphate, and is not accompanied by any great alteration of specific gravity. All these considerations point to the necessity of renewing the charcoal very frequently. With regard to the quantity of charcoal required, much depends on the nature of the sugar. For a ton of sugar, 25 cwt. of good charcoal is amply sufficient; and for fine sugar an equal weight is enough. The less used the better; and

*CHEMICAL NEWS, May 22nd, 1868. (*Am. Repr.*, July, 1868, pages 36, 37, 38.)

it is a mistake to suppose that a large quantity of bad or exhausted charcoal will serve the same purpose as a smaller amount of good. The work will not be so well done, and the waste of sugar will be greater. As illustrations of the composition of old charcoal, the author gives his analyses of nine samples, which differ very remarkably in composition. The percentage of nitrogenous carbon varies from 2.56 to 10.64.

The calcic carbonate in charcoal is useful in neutralising the minute quantity of acid present in all sugars and also the acids always formed during the washing of the charcoal. When very soft water is used, the quantity of calcic carbonate diminishes or even disappears. On the other hand, with very hard waters, or when lime is added in the process, as in the beet factories of the Continent, it often increases to an inconvenient extent. This is best remedied by Mr. Beanes's process, which consists in impregnating the burnt charcoal with perfectly dry hydrochloric gas, exposing it to the air until the excess escapes, washing thoroughly with water and burning. Beanes's process, and others of a similar nature, may be applied with advantage to new charcoal, to bring it at once into efficient working condition.

The oxidising power of the charcoal is attended with a grave inconvenience in sugar refining. When the char cisterns are to be washed off, hot water is introduced, while the heavier syrup descends, but the liquids commingle to some extent, and a weak solution of sugar is formed, which is exceedingly liable to undergo the lactic fermentation. The ferment appears to be generated by the action of the dissolved oxygen of the water under the influence of the charcoal upon the vegetable albumen removed by the charcoal from the sugar. It is a common, but very mistaken custom to use the char washings in dissolving fresh sugar.

With respect to the temperature required in the refining process, the liquor in the blow-up pans should be run off at 180° F.; the char cisterns should be at 155° F., and never below 150°; and the water used for washing should be absolutely boiling. The minimum quantity of water required for refining 100 tons of sugar is about 215 tons, or nearly 50,000 gallons.

Revivifying of the Charcoal.—The reburning of the charcoal is effected in kilns, which consist of upright cast-iron pipes arranged in rows. The wet charcoal is introduced at the top, and sinks down as from time to time the portions which are sufficiently burned are drawn off at the bottom. The flame plays directly upon the pipes, and those which are nearest to it receive the most heat, and their contents must be exposed to it for a proportionately less time—five hours being sufficient for the nearest row, whereas ten hours may be required for the farthest. It is a great mistake not to dry the charcoal, either partially or completely, before introducing it into the kilns, as the wet mass hinders the escape of gases from the lower portions, and much heat is wasted in evaporation.

Evaporation of the Liquor.—This is effected, as is well known, in the vacuum pans. The improvements introduced of late years into the vacuum pans consist in increasing the extent of heating surface and the quantity of water injected into the condenser, and in enlarging the neck of the pan to 18 inches, or even more. A good-sized pan is 10 or 12 feet in diameter, and holds about 20 tons of sugar and syrup. The boiling down occupies two or three hours, the vacuum averages about 28 inches, and the temperature is usually about 120° F. at the beginning, and about 130° at the end of the process. The solution is introduced a little at a time, and the first portion is boiled until a "grain," consisting of almost microscopic crystals of sugar, forms, and these increase in size as the boiling proceeds, until at the finish they are as large as may be desired. When large, distinct crystals are required, the liquid is boiled more slowly and at a higher temperature, and when the pan is full, only one-half of the contents is drawn off. This is repeated several times, the crystals becoming larger every time. The author points out that it is not necessary to increase the temperature, but only to diminish the rapidity of the boiling, in order to obtain fine crystals. The

high temperature usually employed for the production of large crystals only serves to increase the quantity of uncrystallisable sugar formed, and to darken the colour of the syrup.

In boiling down the syrup obtained from the drainage of the first crop of crystals, less care is required, a small grain being preferred as carrying more syrup. Three qualities of sugar are usually prepared by this process, viz., whites, mediums, and yellows. For the yellows, the syrup is evaporated as a "jelly," that is, the formation of grain is entirely avoided, and the jelly is left for several days to crystallise. The crystals of all three kinds are separated from the syrup by a centrifugal machine, the periphery of which travels something like 100 miles an hour. From three to twenty minutes are occupied in the drainage, according to the quality of the sugar. The whitest crystals are sometimes washed with a little cold water.

The PRESIDENT pointed out that other charcoals, not containing phosphate of lime, gradually contracted, and got hard when exposed to long-continued, although not necessarily very excessive, heat. It was well known that coke burnt at a low temperature became extremely dense. He knew from his own experience that light porous charcoal or coke would, if the heat were continued for a very long time, gradually contract. Gold, precipitated in a porous state by a proto-salt of iron, gradually contracted when heated far below the melting point of the metal. Referring to some experiments of his own made many years ago, the President stated his impression that lime really converted sugar into an uncrystallisable state, and that the addition of an acid did not then restore it. It appeared that animal charcoal still held its ground as a decolourising agent, in spite of all the new plans proposed. Its remarkable absorbent power reminded him of that which he had observed in sulphide of lead during his investigations on carminic acid; it entirely removed all the colouring matter, and led to the misapprehension that the cochineal was being changed in its nature.

Dr. HUGO MULLER remarked that lead could not be used with advantage in the treatment of liquids like sugar. Dr. Scheibler had recently found that several liquids of that kind had a very extraordinary power of dissolving and retaining sulphide of lead, and that this lead could not afterwards be separated from them.

Mr. PEARSON deplored the unavoidable absence of Dr. Wallace, as there were many points upon which further information would have been desirable. He commented upon some points connected with the statistics of the trade, and made a few observations on the marvellous powers of animal charcoal. The remarks of Dr. Wallace on the washing out of the products were very important, but, in the south, a limit is rapidly attained in the washing, for even when the New River water was used, it was soon found to be running off purer than when it was put on, from the abstraction of the earthy matters by the charcoal.

Dr. HUGO MULLER stated, in reply to a question put by the President, that the decolourising power of animal charcoal was reduced, though not destroyed, when the phosphates were dissolved out of it by hydrochloric acid.

Mr. WILLIAMS confirmed this statement. The pure charcoal would do more than the common charcoal, bulk for bulk, but there was no comparison in the percentage action of the carbon in the two cases.

Dr. VOELCKER requested permission to ask Mr. Beanes, who was present, the result of his experiments on the decolourisation of sugar by ozone.

Mr. BEANES feared that the ozone process was not yet sufficiently advanced to enable him to speak with certainty about it. His experience so far had taught him that ozonised air, passed through a coloured syrup for three hours, produced as much decolourising effect as contact with animal charcoal for twenty-four hours. His experiments had been unavoidably discontinued for a time, but he hoped shortly to return to them.

Professor WILLIAMSON hoped that some gentleman present might be able to give some information upon one point, which

had been but slightly touched by Dr. Wallace, and which yet was of great importance. He alluded to the relation believed to subsist between the soluble salts of the raw sugar and the crystallisable sugar prevented by them from crystallising.

The PRESIDENT asked Dr. Williamson whether he supposed that these soluble salts merely retained the sugar, or whether they changed it in any way.

Professor WILLIAMSON said that his own information upon the subject was mainly derived from experiments made by another gentleman in his laboratory, and he did not feel justified in going into particulars of them. Some salts appeared to possess the property of retaining sugar in solution, while others had an opposite property, and actually accelerated its crystallisation.

Dr. VOELCKER remarked that beet-root sugar often contained a good deal of common salt. Now, as beet-root contained no fruit sugar, and yet salt was present, it would seem to point out that chloride of sodium had not the effect of changing the nature of the sugar, but simply of preventing in some measure its crystallisation. That it had the latter power was well known, and sugar refiners dreaded its presence more than that of almost any other salt.

The meeting then adjourned to the 18th inst.

Thursday, February 18, 1869.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

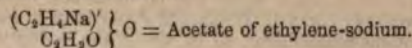
THE meeting opened with the usual formal business, after which

The PRESIDENT announced that the following gentlemen had been selected by the Council, and were recommended to the Society for election as officers, at the anniversary meeting:—As President—Dr. FRANKLAND; as Vice-Presidents—Dr. WARREN DE LA RUE, Dr. NOAD, Dr. ODLING, and Dr. REDWOOD; as Secretary, Mr. PERKIN (in place of Dr. Odling, whose services had done so much to contribute to the prosperity of the Society); as Treasurer—Mr. ABEL; as Members of Council—Mr. MAXWELL SIMPSON, Mr. CHAPMAN, Mr. HANBURY, Mr. PRESTWICH, Dr. VOELCKER, and Mr. GREVILLE WILLIAMS.

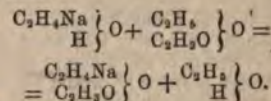
He (the President) had another announcement to make, which, he thought, would be extremely gratifying to the Fellows of the Society. The Council had had some anxiety in selecting a distinguished chemist to inaugurate the Faraday lectureship, recently established by the Society; it was felt, that, to do due honour to the distinguished philosopher whom we had lost, we could not do less than seek among the greatest names for one who would accept the duties for which the medal was to be conferred. The Council had applied in the first instance to M. Dumas, whose name was well known to every one present, who was a chemist before some of them were born, whose long career as a man of science, a statesman, and a promoter of the welfare of science, had been so distinguished, and who, above all, had been one of the most intimate friends of Mr. Faraday. M. Dumas had at last consented to accept this post, and this would, of course, necessitate a great number of preparations. A fitting arena for the discourse must be provided; and, through the instrumentality of Dr. Odling, arrangements had been made by which the theatre of the Royal Institution had been secured for the purpose. No site could be fitter for the purpose than that in which Faraday had enunciated so many of his grand discoveries. The discourse would, of course, be delivered in French; but that could be a matter of very little moment, as all the Fellows of the Society were probably acquainted with the French language. It was hoped that M. Dumas's visit to England might be rendered pleasant, and at a future time some little scheme would be laid before the Fellows of the Society by which a fitting welcome might be prepared for him. The discourse would probably be delivered in the month of May, but further information would be given to the Fellows in the course of six weeks or two months.

Professor WANKLYN then gave a verbal account of his ex-

periments on ethylate of sodium. He had arrived at the result that the so-called absolute ethylate of sodium is really the hydrated oxide of a new kind of organo-metal. He had also obtained a set of salts of the new radical—for instance, the acetate, valerianate, and benzoate of ethylene-sodium. The formula of the first is—

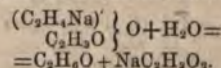


It is obtained by the action of acetic ether on absolute ethylate of sodium, thus:—



Alcohol is, as will be observed, the complementary product.

The new salts which are isomeric with salts of a higher fatty acid, are characterised by being decomposed by water into ordinary soda-salts and alcohol, thus:—



The elimination of alcohol in this reaction shows that the olefine is associated, not with the acid part, but with the metallic part of the compound. Mr. Wanklyn regarded sodium as triatomic in these compounds.

Mr. CHAPMAN said that if the rotative amyle alcohol were taken, sodium dissolved in it, water added, and the whole distilled, an alcohol of the same rotative power was obtained; if, however, dry alcohol was treated with sodium, the alcohol distilled off, and the residue heated to about 200°, or rather over, this residue remained perfectly white and colourless, and had the composition of what was ordinarily called amyle of sodium. If water was now added, the alcohol yielded on distillation was no longer rotative. Its boiling point was lowered from 132° to about 124°; and the speaker was strongly inclined to believe that it was identical with the hydrate of amylene discovered by Wurtz. It did not yield valerianic acid on oxidation, and its specific gravity was altered. It would be somewhat curious if this observation, made almost at the same moment, were to receive explanation by Mr. Wanklyn's description of these olefine compounds.

Dr. ODLING, without presuming to call in question the interpretation given to his researches by Mr. Wanklyn, whose powers of penetration into chemical phenomena were so well known, and who had had time to consider the subject carefully, remarked that it was easy to understand a difference between such a body as hydrate of sodium ethyl, or sodium ethylene, and ordinary sodium ethylate; but that if this sodium were replaced by hydrogen, he did not see how a difference could be figured between hydrate of a hydrogen ethylene and hydrate of ethyl—how, in fact, such a body could differ from common alcohol, unless, indeed, we were to give to the hydrogen a triatomicity corresponding to that which Mr. Wanklyn ascribes to sodium.

Professor WANKLYN thought that the explanation was that the sodium was combined twice with carbon, and if hydrogen were put in place of the sodium, he did not assume that the hydrogen would afterwards have the combining power that the sodium had. It amounted to this—that the sodium had interfered with the combination at two points, and so converted a normal into an abnormal action.

Mr. CHAPMAN thought that this anhydrous ethylate of sodium would yield common alcohol, whereas the anhydrous amyle, or amylene compound, would, in the same way, yield an abnormal alcohol. The splitting of the alcohol into olefine and water, or the representatives of water, appeared, as Mr. Wanklyn said, to be a result of the disturbance of the relations of the alcohol.

Dr. ODLING remarked that Mr. Wanklyn appeared to think that the alcohol obtained by replacing the sodium of the ethylene compound by hydrogen, would differ from common alcohol,* whereas Mr. Chapman held a contrary opinion. If a different alcohol were obtained, under these circumstances its constitution could not be explained by our at present received notions. We should either have to assume that the atoms remembered, so to speak, the bodies which they replaced, or we must go into the question whether all the atoms of hydrogen in the methyl residue had the same value. This last notion was floating in chemists' minds, but had hitherto received no demonstration.

Mr. MILLS thought that there was some ground for the opinion as to the identity of the different atoms of hydrogen in marsh gas, though perhaps he would not have expressed the fact to which that opinion referred in exactly the same way. In the oil known as Marignac's oil, which was marsh gas, in which half the hydrogen was replaced by chlorine, and the other half by nitrile (NO_2), one half of the nitrile had undoubtedly a different function from that of the other half, inasmuch as on heating with hydriodic acid, one-half became ammonia and the other half nitric oxide. A great deal of further support from fact would, however, be required before the floating opinion, to which reference had been made, as to a difference between the different hydrogens in marsh gas could be generally received; and when it was received it would not support any atomic hypothesis, but would, on the contrary, tend to a much greater result, namely, to make chemistry more dynamical and less statical than it unfortunately was at present.

The meeting then adjourned to Thursday, March 4th, when a lecture will be delivered by Mr. Tomlinson, F.R.S., "On Catharism, or the Effects of Chemically-Clean Surfaces."

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION.)

A MEETING was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst., at eight o'clock in the evening, James Couper, Esq., St. Rollox Chemical Works, in the chair. One new member was admitted, and one candidate proposed.

A paper was read by P. M. MOIR, Esq., "On the Preservation of Timber," which we shall endeavour to give as fully as possible in our next.

ACADEMY OF SCIENCES.

PARIS, 11th AND 18th JANUARY, 1869.

The Solution of Sulphur.—Photographing on Enamel.—Hydrogen and Palladium.—Physiological Action of Conia, Ethylconia, and Iodide of Diethylconia.

At the meeting of the Academy on the 11th of January, M. Lefort contributed a note on the solution and estimation of sulphur by means of aqua regia, and M. Duchemin a note on photographing on enamel.

The enamel used for painting and photography is composed principally of silica, oxide of tin, and oxide of lead; the mixture is melted on copper, gold, or platinum. Besides the high price, the enamel produced in this way is defective in not possessing a flat surface, in consequence of which the photographer is obliged to transfer the image on to the enamel. Crown glass covered with a fusible enamel, having arsenic for the base, can replace very economically the surfaces obtained by the more expensive method. M. Duchemin gives the processes most suitable for this branch of photography.

M. Lefort describes the action of aqua regia on sulphur to be, firstly, the formation of chloride of sulphur; secondly, the destruction of this compound by nitric acid or its deriva-

* We believe that Professor Wanklyn did not intend to convey this impression.—Ed. C. N.

tives; and consequently the regeneration of the chlorine, the evolution of nitrous vapours, and the formation of sulphuric acid. In proportion to the amount of nitric acid present, is the solution of the sulphur quickly arrived at. The most convenient mixture of hydrochloric and nitric acids for dissolving sulphur, is made with 1 volume of the former and 3 of the latter.

At the meeting on the 18th of January, a memoir was communicated by Professor Graham, on hydrogen in its relations with palladium, a memoir with which your readers are already acquainted. M. Wurtz, in commenting upon the results set forth in this memoir, remarked that he had formerly attempted to prepare a hydride of palladium by the process which enabled him to prepare a definite combination of hydrogen and copper, viz., the reduction of sulphate of copper by hypophosphorous acid. When an excess of a solution of this acid is added to the solution of a palladium salt the liquid becomes turbid, and in a few minutes a finely divided brown precipitate is deposited. Nearly immediately, and even at 0° , an evolution of hydrogen is manifest, and if heated the evolution of gas becomes very brisk. As soon as the hydrogen ceases to come off the liquid begins to clear, and the precipitate now appears black and flocculent—this precipitate is palladium. From these facts it would seem that the pulverulent and amorphous palladium precipitated by hypophosphorous acid is incapable of retaining hydrogen.

The only other memoir we have to notice from this meeting is one by MM. Pellissard, Jolyet, and A. Cahours, on the physiological action of ethylconia and the iodide of diethylconia compared with that of conia. Ethylconia and the iodide of diethylconia lead, like conia, to a rapid poisoning of the pneumogastric nerves, differing at the same time in possessing a less energetic and more passing action on the voluntary nerves. In equal conditions, conia is more poisonous than ethylconia, which is again more poisonous than the iodide of diethylconia. Thus, a relatively longer time is required for ethylconia to destroy nervous excitability than for conia, and with the iodide of diethylconia, the movements of the nerves are never more than weakened. It is a fact worthy of remark that the introduction of the radical ethyl with the conia abolishes the period of convulsions which precedes the paralysis in poisoning by this alkaloid: the fact is particularly seen in poisoning by iodide of diethylconia, where the animal falls incapable of making voluntary movements without this paralysis being preceded by the slightest convulsions.

Thus the introduction of ethyl with conia produces similar results to the introduction of this radical into strychnia.

PHARMACEUTICAL SOCIETY.

Wednesday, February 3, 1869.

T. H. HILLS, Esq., Treasurer, in the Chair.

Dr. ATTFIELD had already contributed three notes on the following subjects:

Citrate of Quinine.—A mixture, consisting of sulphate of quinine, citric acid, citrate of potash, and water, contained a deposit which prevented the proper apportionment of the dose; an analysis proved it to be citrate of quinine, and, by first rubbing the solid with a little of the water, a mixture was obtained which admitted of the proper dose being taken.

Aromatic Sulphuric Acid.—Experiments proved that the official preparation contained no sulphovinic acid, as had been supposed by some pharmacists.

The Adulteration of Precipitated Sulphur.—An analysis of eight samples showed that only one was pure, one contained nearly half its weight of calcareous matter, and each of the others contained two-thirds impurity, and only one-third precipitated sulphur.

At the present meeting, Dr. ATTFIELD read seven other notes: the first was on

Crystallised Carbonate of Magnesium.—Some unusually

large crystals of pentahydrate carbonate of magnesium had been forwarded—the largest was 13 m.m. long, 9 wide, and 6½ thick. They were converted, by exposure, into the terhydrous salt. 324 of a gramme yielded, on analysis, 0.945 of MgO; 100 parts gave, by experiment, 29.167, and by calculation, 28.988.

Arsenical Playthings.—The author had analysed the wings of a toy bird, and also the label of a cotton reel, both of which contained arsenic; such toys should, therefore, be kept from the mouths of children.

The Separation of Tin from Antimony.—By the usual mode of separating these two metals, too little antimony, and too much tin is often obtained. Noticing the best numbers were obtained when the operation was quickly performed, the author endeavoured to find out whether metallic antimony reduced ferric salts to ferrous, the antimony becoming dissolved by the influence of the excess of acidulous radical in ferrous salts over and above that in ferric salts. He warmed two solutions of chloride of antimony—one in a flask, the other in a beaker—adding to each metallic iron and hydrochloric acid. When the iron had disappeared, the flask was tightly corked and the beaker left uncovered. In forty-eight hours the antimony in the beaker had re-dissolved; but on testing the liquor in the flask no antimony was discovered. On digesting finely powdered metallic antimony in solution of ferric chloride, slow reduction to ferrous chloride took place, the liquid taking up antimony; so that, in precipitating antimony by iron, to estimate the amount of antimony, air must be excluded until all ferrous salt is washed away.

On a Crystalline Deposit in Opium Liniment.—On mixing a liniment often used in pharmacy containing laudanum, a greenish-yellow semi crystalline precipitate formed, which was analysed to ascertain if it contained any of the active principles of the opium. It was found to consist of the acid meconates of potassium, and mainly sodium with a little sulphate of calcium; its presence was, therefore, of no moment.

In reply to a member, Professor ATTFIELD said it contained no morphia.

Mr. MORSON remarked that the morphia would be kept in solution by the ammonia.

Sulphate of Potassium in Ergot.—In preparing the Ext. Ergot Liq. B. P., a pharmacist had, after mixing the spirit of wine, set the mixture aside during a night instead of one hour. The sides of the vessel were lined with crystals, which Dr. Attfield found to consist of the inert salt of sulphate of potassium. They amounted in weight to about 3 per cent of the ergot employed. After reading the note, the author read a letter from Mr. Holloway, of Sydenham, who sent a sample of powdered ergot, which he had kept in a corked bottle since 1866, by adding about 20 per cent of spirit of wine; it was in a good state of preservation.

White Precipitate.—Six specimens were examined in reference to volatility, fusibility, and percentage of mercury: all volatilised on being heated, without leaving a trace of residue. On sublimation, one partially melted and one liquefied entirely, the others were infusible. The percentage of mercury was as follows:—

Mercury in 100 parts.		
No 1.....	volatile	infusible 78.59
" 2.....	"	" 77.87
" 3.....	"	" 76.44
" 4.....	"	" 75.11
" 5.....	"	partly fusible... 73.08
" 6.....	"	fusible..... 72.00

The author recommended that in the next Pharmacopœia the quality of infusibility should be included in addition to the percentage of mercury.

Mustard Cake.—Dr. ATTFIELD had analysed a sample of mustard cake which was prepared by pressing the husks of the seeds when hot. It was sold principally for manure, but farmers were liable to get it instead of linseed cake. The following is the analysis:—

Water.....	11.00	per cent.
Ash.....	8.00	"
Fibrous matter.....	12.25	"
Oil.....	14.00	"
Albumenoid matter.....	31.70	"
Mucilaginous matter.....	22.50	"

Sulphurous Acid.—Mr. UMNEY read a laboratory note "On Sulphurous Acid," in which he showed that the official solution of 9.2 per cent could only be obtained with difficulty. The described specific gravity did not coincide with its percentage of acid. He had examined several specimens, and found they contained only from 2 to 6 per cent of real acid. Results of experiments on a large scale showed that the specific gravity of strong acid, as ordinarily obtained, was from 1.025 to 1.030. The author suggested that a solution of 1.027 sp. gr., and containing 5 per cent by weight of real acid, be substituted for the official solution.

Mr. HANBURY had always found the strength of sulphurous acid inferior to that ordered in the Pharmacopœia.

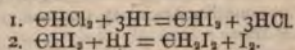
Dr. ATTFIELD remarked that either the Pharmacopœia process or the percentage was wrong.

The CHAIRMAN thanked Dr. Attfield and Mr. Umney for their communications, and announced that the next meeting would take place on the 3rd of March.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

On the Desulphuration of Chemical Combinations.—In this research the properties of hexanilide and its compounds with chlorhydric, nitric, sulphuric, and oxalic acids, and the analogous compounds of hexatoluide derived from toluidine are examined and completed. These bodies proceed from the desulphuration of sulphocarbonilide and of sulphotoluide. The authors have also observed the action of nascent hydrogen upon these substances. The final product is aniline with the first body and of toluidine with the second. The sulphocyanogen or sulphocyanide of potassium produces sulphuretted hydrogen and methylaniline. (*Journ. de Fittig.*)

Conversion of Organic Chlorides into Iodides.—A. Lieben—Organic chlorides are converted into iodides by the action of concentrated iodic acid. This method of conversion seems to be a general one, and subject to limitation only in so far as some iodides at the moment of their formation are converted into hydride. Ethyl chloride, at 130° C., is almost completely converted into iodide, without evolution of gas or formation of any by-product. The same is the case with butyl and amyl chloride. Chloroform is converted into methylene di-iodide according to the following equations:—

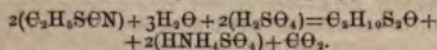


(*Akad. z. Wien*, 58, 1868.)

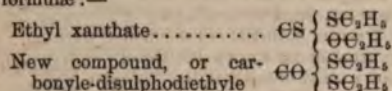
Guanidine from Chloropierin.—A. W. Hofmann.—Guanidine may be readily prepared in large quantities by heating chloropierin, with a strong alcoholic solution of ammonia, to 100° C. for several hours, and extracting the mixture of salts thus obtained with absolute alcohol. Guanidine nitrate, $\text{CH}_5\text{N}_3\text{HN}_3$, is precipitated as a crystalline powder by adding to the chlorhydrate a solution of potassium nitrate. It forms with silver nitrate the compound $\text{CH}_5\text{N}_3\text{AgNO}_3$; the chlorhydrate gives with gold trichloride, $\text{CH}_5\text{N}_3\text{HClAuCl}_3$. Dry guanidine chlorhydrate dissolves in aniline; on heating the solution, ammonia is given off, and the residue contains a compound of the composition of, but differing from, melaniline, $\text{CH}_3(\text{C}_6\text{H}_5)_2\text{N}_3$. (*Deut. Chem. Ges. Berlin*, 145, 1868.)

Sulphuric Acid and Ethyl Sulphocyanate.—Schmitt and Glutz.—On acting upon ethyl sulphocyanate (1 vol.) with concentrated sulphuric acid (2 vols.) a violent disengagement of carbonic anhydride takes place, and a

compound is formed which is isomeric with ethyle xanthate. To obtain it, the products of the reaction are mixed with water and distilled, when it goes over together with water as a heavy oil of the composition $\text{C}_8\text{H}_{10}\text{S}_2\text{O}$. It has the smell of garlic, is insoluble in water, soluble in alcohol, ether, and strong sulphuric acid. It boils at $196-197^\circ\text{C}$. Its formation is shown by the following equation:—

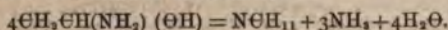


The new compound gives with alcoholic potassium hydrate—potassium carbonate and mercaptan; with alcoholic ammonia—urea and mercaptan; with water at 160° —carbonic anhydride and mercaptan. The constitutional difference between it and its isomer is represented in the following two formulae:—



The authors have in a similar manner prepared the corresponding methyl and amyl compounds; they boil at 169° and 281° respectively. The reaction in the cases of allyle sulphocyanide and ethylene sulphocyanide seems to be of a different nature.—(*Ibid.*, 166, 1868.)

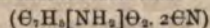
Aldehydine.—E. Ador and A. Baeyer.—If aldehyde-ammonia, urea, and ammonium acetate are heated together to $120^\circ-130^\circ\text{C}$, and oil of the composition N_2H_{11} —aldehydine is obtained. It floats upon water, in which it is slightly soluble; its boiling-point is 175° . It smells like conine, from which it differs in composition by a minus of H_4 ; it cannot, however, be converted into the latter by the action of sodium amalgam. With chlorhydric acid, aldehydine forms a crystalline salt. The following equation illustrates the mode of its formation:—



—(*Ibid.*, 189, 1868.)

Derivatives of Hippuric Acid.—P. Griess.—1. *Oxyhippuric acid*, $\text{C}_8\text{H}_8\text{N}_2\text{O}_4$, is formed by boiling an aqueous solution of sulphuric-diazohippuric acid. When the evolution of nitrogen has ceased, the acid solution is neutralised with ammonia, evaporated on the water-bath, and the acid liberated by adding chlorhydric acid. It crystallises in needles, and is readily soluble in hot water, alcohol, and ether, sparingly in cold water. 2. *Iodhippuric acid* is prepared by the action of aqueous iodhydric acid upon sulphuric-diazohippuric acid. The raw product is dissolved in ammonia, decoloured by means of animal charcoal, and precipitated with chlorhydric acid. The acid is soluble in alcohol, moderately soluble in hot water. On recrystallisation it is obtained in large leafy crystals resembling naphthalene. Its constitution is represented by the formula $\text{C}_8\text{H}_7(\text{NH}_2)\text{O}_3\cdot\text{C}_2\text{H}_4\text{IO}$; that of Maier's iodhippuric acid with which the former is isomeric, $\text{C}_8\text{H}_7\text{NH}_2\text{O}_3\cdot\text{C}_2\text{H}_4\text{IO}$.—(*Ibid.*, 190, 1868.)

New Bases.—P. Griess.—Amongst the products of dry distillation of cyan-amidobenzoic acid—



is an oil of basic properties. After purification it crystallises in needles which fuse at 53°C , and can be distilled without decomposition. The composition of the base is $\text{C}_7\text{H}_5\text{N}_2$, and it forms well-defined salts. Another base, of the composition $\text{C}_7\text{H}_5\text{N}_2\text{O}_2 + 2\text{H}_2\text{O}$, may be obtained from $\text{C}_7\text{H}_5(\text{NH}_2)\text{O}_2, 2\text{CN}$ by boiling with a strong solution of potassium hydrate or chlorhydric acid. It crystallises with two molecules of water, which escape at 120°C , and it cannot be distilled without decomposition. It dissolves in aqueous potassium hydrate, and is precipitated therefrom by carbonic anhydride; its salts are crystalline. This base may be considered to be composed of two atoms of amidobenzoic acid and one atom of oxamide—

$2\text{C}_7\text{H}_5\text{N}_2\text{O}_2 + \text{C}_2\text{H}_2(\text{NH}_2)_2$, but it cannot be resolved into these constituents by boiling with acids or bases.—(*Ibid.*, 191, 1868.)

NOTICES OF BOOKS.

Disinfectants and Disinfection. By ROBERT ANGUS SMITH, Ph.D., F.R.S., F.C.S. Edinburgh: Edmonston and Douglas. 1869.

By common consent, Dr. Angus Smith has become the first authority in Europe on the subject of disinfectants. To this subject he has devoted a large portion of his scientific life; and now, in a compact volume of only 138 pages, he has condensed the result of twenty years of patient study. We cannot too much commend the plan and execution of this inquiry. Almost every page contains evidence of exhaustive, laborious research, guided in its course by the clearest judgment. We seek in vain for some weak point to give us occasion to air our critical acumen. Our duty, therefore, must be confined mainly to giving extracts—criticism being out of the question—for no man living is competent to criticise Dr. Angus Smith on disinfection but Dr. Angus Smith himself.

This book contains within itself the whole subject of disinfection down to the present time. The author draws his information from all ages; he discusses the perfumed pomades of the ancients; the conserve of roses of the Athenians; the purification by fire of the Hindoos, of Hippocrates, and of Zeno of Constantinople; the labours of Hercules, who saved the Elians by draining their marshes; the embalming of the Egyptians; the sulphur fumigation of Ulysses; the anæsthetics mentioned by Pliny and Galen applied to surgical operations. He discusses these with the more modern experiments of Dr. Petit, Sir John Pringle, Guyton Morveau, Dr. Carmichael Smith, Fourcroy, Hildenbrand, Dr. Henry, and others; and, comparing their processes with those adopted in our own time, shows that throughout the immense mass of empiricism of a bygone time there runs a thin thread of gold, which he has interwoven with his own researches, and so raised the whole subject to the dignity of an exact science.

It is little surmised how much the ancients knew of sanitary subjects. That sewer air is unwholesome is a proposition which has taken, in our time, Commissioners and Boards of Health many years of hard labour to dig into the apprehension of the British public; yet, even in Justinian's Digest, in quotation from Ulpian, it is evident that this question was then practically settled. Justinian says, "The prætor took care that all sewers should be cleansed and repaired for the health of the citizens, because uncleansed and unrepaired sewers threaten a pestilential atmosphere, and are dangerous." The world is obliged occasionally to revive its principles.

As an illustration of the exhaustive manner in which Dr. Smith treats his subject, weighing and balancing opinions like a judge rather than insisting upon them as an advocate, we may give the following quotation:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act as if planted by seed, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result here would seem to be, that whilst the decomposition of organized beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases, and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however,

is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is and has always been—What is the nature of that substance which may be said to form the seed or germ of the disease? Chemists have been inclined to consider it a substance in process of decay. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that, when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere, and that they are the cause of some hitherto entirely mysterious phenomena, even putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars, and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous inquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action, have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death.”—(p. 20.)

Incineration has been advocated of late as a means of obviating the danger occasioned by the multiplication of dead bodies in and about large cities: Dr. Angus Smith puts the subject in a new light:—

“Many people think that we ought, like some of the ancients, to burn our dead. They do not consider what a terrible proposal they are making. To burn a body without producing the smell of burning flesh is a most difficult thing, and far surpasses the problem of burning our smoke, which, however important, is still left undone. The expense of keeping up such a lake of fire as to consume all our dead would also be, in all probability, too great; let us imagine 1500 bodies roasted to ashes in London every week. We shall not enter into the details of such a large manufactory of phosphates, as we must call it, because it is painful to dwell on the horrors of the picture, and conjure up the details.”—(p. 5.)

Many other quotations we should like to give, but since every page contains subjects of interest and value, to quote all the noteworthy passages would be to reprint the book.

To sanitary officers, to municipal and parochial authori-

ties, and indeed to all who are practically concerned for the public health and life—and who is not?—we sincerely commend Dr. Angus Smith's treatise.

Hints to Purchasers of Jewellery and of Watches, with an Account of the Relative Value of the Different Qualities of Gold. By EDWIN W. STREETER, 37, Conduit Street, Bond Street. Tenth Edition. London: Simpkin, Marshall, and Co.

THIS neat little work should be studied by all purchasers of jewellery, for in nothing can the inexperienced be so easily duped as in the purchase of gold and silver ornaments. The first part of the book contains some valuable hints on quality and workmanship which, if adopted, will soon lead to the public obtaining a fair value for their money. With regard to the quality of gold, our author very properly remarks that “Colour is no guide, as it may be gilded; weight is no guide, as it may be loaded with lead; pattern and finish tell for nothing to the inexperienced eye,” but to prevent deception, the purchaser has only to make himself familiar with the standard estimates and to request that the quality be stated on the invoice. The stamp of Goldsmith's Hall is thought by most persons sufficient security, but this is not the case with gold, for the same acts of Parliament allow gold to be marked and sold from standard of 22 carat, worth £3 17s. 10½d. per oz., to an alloy containing gold of 1 carat, worth only 3s. 6d. per oz.

The second part contains a most interesting description of the manufacture of jewellery and watches by machinery. The space allotted to this notice will not allow of our commenting more at length on this division, suffice it to say that a presentation watch seen by us and made entirely by machinery at Mr. Streeter's Establishment proves the great advantages gained by economising labour and thereby greatly reducing the cost.

This readable little book is beautifully printed on fine toned paper and we commend its perusal to our readers.

CORRESPONDENCE.

Oleographs.

To the Editor of the CHEMICAL NEWS.

SIR,—May I be permitted to reply to Mr. Tomlinson's courteous letter in your last issue (*Am. Repr.*, March, 1869, page 157), respecting our oleographs. Mr. Tomlinson says he cannot speak favourably of the impressions I sent him as types of cohesion figures. The oleographs I transmitted to him, and also to yourself and many others, were patterns of three or four different oils taken at random, little or no attention being paid to the time to which the oils were exposed on the water; I simply desired to show what could be done by this beautiful process. Mr. Tomlinson says that “there is a moment in the existence of every film when the characteristic figure is presented, by which it can be recognised and the purity tested.” I can truly aver that such is the case, and also that our process of oleography is capable of receiving the perfect figure at the right moment and in an instant. The oleographic process needs only to be tried by any one to show its capabilities in this way. Lard, tallow, linseed, and many other oils, produce patterns, when placed on water, which there is no mistaking. Some oils develop their figures in a few seconds after they are placed on the water, and the paper we use will take up the pattern at once; so that by taking impressions of the same oil at different lengths of time, we have a series of oleographs produced which are of the greatest value in determining the purity of the oil. I am most desirous of enforcing that the period of time taken to produce a given pattern is an indispensable element in the proper testing of any oil.

Now when I set about the examination of any oil, I

arrange six plates of water and let fall a drop on each, most accurately taking the time of exposure, and fixing the various patterns, so that I now have the oil in all its stages of development. For instance, take off the patterns every ten seconds up to three minutes, or beyond that time if necessary, as there are some oils which take a long time to develop their distinguishing design. Now compare these fixed patterns with those of any other oil taken under exactly similar circumstances, and the value of the test is at once manifest. Oleography is a process for fixing the patterns of oils, and thereby rendering them available for comparison.

Mr. Tomlinson appears to work much with oils of little commercial interest, as coriander, lavender, &c. Oil merchants are not as a rule interested in these oils; the oils of sperm, rape, linseed, lard, tallow, olive, cotton, and their adulterations chiefly engage their attention. In oleography we have a certain means of estimating their genuineness and in many cases their adulterants. Respecting the colours of the oil films I am almost sure no one will ever be able to make anything of, as they are simply, I believe, the result of a property of the oil to decompose light.

For the value of oleography as a test for oils I would respectfully ask the opinion of those who are now engaged in working out results. At the request of a number of oil merchants here we are issuing an "Oleographic Album," containing the authentic oleographs of any oils desired and made by myself in the laboratory.

Some little time ago I asked a public opinion from Mr. Tomlinson regarding this process of oleography as a test for oils, and for his kindly doing so I beg heartily to thank him.—I am, &c.,

R. CARTER MOFFAT, Ph.D.

Laboratory, Mechanics' Institution, Glasgow,
22 Feb. 4th, 1869.

Uniformity in taking "Igniting Points."

To the Editor of the CHEMICAL NEWS.

SIR,—I cordially subscribe to Mr. Hutton's remarks on the above subject in your late issue:—"Without a uniform method no two results will agree; but with a recognised method both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a security to consumers and others that does not now exist would be obtained." Public attention having of late years been much directed to the danger attending the transit, storage, and employment of oils, spirits, and other inflammable materials, it is highly desirable that all chemists should adopt some conventional method of determining the degree at which indefinite volatile liquids give off vapour sufficiently fast to afford a distinct flash on the approach of flame—the *igniting point*, *firing point*, or *flashing point*. Now the Petroleum Act, which came into full operation on February 1st, contains a schedule wholly devoted to "Directions for applying the flashing test to samples of petroleum oil;" this method was drawn up by Professors Abel, Letheby, and myself, is the only recognised legal process, and is, therefore, I submit, the one which should be adopted by chemists in ascertaining the firing point of liquids other than petroleum.*

In taking the flashing points of fixed oils for the Fire Offices, my colleagues, Professors Roscoe and Penny, and I employ a porcelain crucible, similar in size and shape to the test-vessel described in the Petroleum Act, and adopt the important precaution of protecting the stem of the thermometer employed by an outer glass tube; we thus arrive at tolerably concordant results.

I have appended the schedule of the new Act, as I believe it has not yet been printed in your journal. With regard to the Act itself it may be as well to observe that in the eye of the law petroleum is not petroleum if its legal flashing

point is above 100° F, and no license is necessary for its sale or storage; while all mineral spirits or oils are, legally, petroleum if their flashing point is below 100° F. Traders in the latter must hold a license from one of the authorities mentioned in the Petroleum Act of 1862, and must label bottles and other vessels containing the liquid with the precautionary words mentioned in the 5th section of the Act of 1868.—I am, &c.,

JOHN ATTFIELD.

"SCHEDULE."

"Directions for applying the Flashing Test to Samples of Petroleum Oil.—The vessel which is to hold the oil shall be of thin sheet iron; it shall be two inches deep and two inches wide at the opening, tapering slightly towards the bottom; it shall have a flat rim, with a raised edge one-quarter of an inch high round the top; it shall be supported by this rim in a tin vessel four inches and a half deep and four and a half inches in diameter; it shall also have a thin wire stretched across the opening, which wire shall be so fixed to the edge of the vessel that it shall be a quarter of an inch above the surface of the flat rim. The thermometer to be used shall have a round bulb about half an inch in diameter, and is to be graduated upon the scale of Fahrenheit, every ten degrees occupying not less than half an inch upon the scale.

"The inner vessel shall be filled with the petroleum to be tested, but care must be taken that the liquid does not cover the flat rim. The outer vessel shall be filled with cold, or nearly cold, water; a small flame shall be applied to the bottom of the outer vessel, and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one and a half inches beneath the surface. A screen of pasteboard or wood shall be placed round the apparatus, and shall be of such dimensions as to surround it about two-thirds, and to reach several inches above the level of the vessels.

"When heat has been applied to the water until the thermometer has risen to about 90° Fahrenheit, a very small flame shall be quickly passed across the surface of the oil on a level with the wire. If no pale blue flicker or flash is produced, the application of the flame is to be repeated for every rise of two or three degrees in the thermometer. When the flashing point has been noted, the test shall be repeated with a fresh sample of the oil, using cold, or nearly cold, water as before; withdrawing the source of heat from the outer vessel when the temperature approaches that noted in the first experiment, and applying the flame test at every rise of two degrees in the thermometer."

Estimation of Phosphorus in Iron and Steel.

To the Editor of the CHEMICAL NEWS.

SIR,—I read with some surprise in your account of the "Proceedings of the Chemical Society" on Thursday, January 21 (*Am. Repr.*, March, 1869, page 146), an observation by Dr. Miller that "the old method of estimating phosphorus (in iron and steel), which involved the throwing it down as iron-salt, was unreliable."

For many years I have been in the habit of using this method, which I regard as quite as accurate as the phospho-molybdate process of Eggertz and not nearly so tedious.

I am constantly engaged in the determination of phosphorus and phosphoric acid in iron and iron ores; every process that has been recommended has been submitted by me to the most careful examination, and I have rejected all in favour of the old plan, which, I am confident, will, if carefully executed, satisfy the requirements of the most fastidious chemist.

Among the precautions necessary to insure accuracy when dealing with iron and steel containing very small

* The apparatus may be obtained at Casella's.

amounts of phosphorus may be mentioned that of not operating on too bulky solutions. When estimating phosphorus in iron and steel, I work on from 75 to 100 grains, and the solution, at the time of adding the tartaric (or citric) acid, ammonia, and sulphate of magnesia, is never allowed to exceed in volume 3 fluid ounces. The first precipitate always carries down a little iron, which is removed by re-solution and re-precipitation after the addition of a fresh small quantity of tartaric acid. I never collect the first precipitate till after the liquid has stood for twenty-four hours; the second precipitate is quite white, and may be filtered off after half an hour, and I am quite confident, from very long experience, that it contains the whole of the phosphoric acid. I have recently been using this method in cases where the amount of phosphorus has not exceeded 0.02 per cent.

I do not say that the phosphate of iron process is superior in point of accuracy to the phospho-molybdate process, but I do assert that it is quite as trustworthy and far less troublesome.—I am, &c.,

HENRY M. NOAD.

St. George's Hospital,
Feb. 1, 1869.

Chemical Affinity and Electricity.

To the Editor of the CHEMICAL NEWS.

SIR,—A course of experiments on electric decomposition has led me to a line of thought which appears to promise a great simplification of chemical and electric theory.

We are accustomed to speak of bodies as being formed and held together by the strength of chemical affinity and decomposed by virtue of a stronger; thus silver dissolves in nitric acid because of their affinity, while copper displaces the silver, and zinc in turn the copper, by their relatively greater affinities for the acid.

We also suppose that the galvanic current effects decomposition by means of its greater force, attacking the molecule and overcoming the affinity which holds it together; in fact, by a conflict in which the strongest force conquers.

Is not the true theory exactly the reverse in both cases? In the example noted, the silver in dissolving gives out heat; the copper in precipitating does the same, and the zinc repeats the process, the three heats together being equal to that which the zinc alone would give in dissolving. Now surely the loss of heat cannot be an indication of increased forces.

Among the old subdivisions of affinity, predisposing affinity played a great part in chemical reactions. Now, as heat has a strong tendency to radiate away into space, is it not highly probable that this is the predisposing cause of chemical reactions—that bodies will combine together, or alter their forms of combination whenever the latent heat essential to the new form is less than that of the old, and the conditions permit the free motion of the atoms and the setting free of heat?

In this light the amount of heat set free in any action is the measure of the so-called affinity at work; this is already well-known as a fact, but hitherto it has been treated as a mere incidental consequence of the reaction. Is it not rather the sole effective cause?

This view gives at once a clear explanation of the decomposing action of the galvanic current. It is well known that different substances present different resistances, and therefore require varying electro-motive force in the current, and the reason is, not that the force of affinity has to be subdued, but that to enable the elements of a compound to resume their separate forms, we must recharge their atoms with the amount of force they lost in the act of combining. This is done by the electric current, whenever each molecule, the pulsations of which constitute the current, is charged to the necessary degree, and unless the electro-motive force is raised to that degree, the molecules cannot move or the current pass. The same effect is produced by heat, only when its temperature is raised to the corresponding degree, when the mole-

cules become charged with the force necessary to their separate existence; then, if other circumstances are such as to permit the component elements to be removed from each other and thus prevent immediate recombination, the force becomes latent and decomposition is effected.

* Thus chemical combination is due to the loss or escape of combined or latent force. Chemical decomposition is due to force becoming latent or attached to the atoms.

This view of force brings into relation many things at present looked upon as exceptional, and furnishes a general law for all chemical phenomena; thus it shows why reactions always occur when an insoluble substance, or a less soluble one can be produced, because that implies less latent heat, and it explains the difficulties of disassociation of vapours, because that must occur when the temperature charges the atoms with the force necessary to their separate existence, though if not separated, they reunite as soon as the temperature falls below that point.—I am, &c.,

JOHN T. SPRAGUE.

The New Petroleum Act.

To the Editor of the CHEMICAL NEWS.

SIR,—In answer to many inquiries, as well as to the question by "A Wholesale Firm," in your last issue (*Amer. Repr.*, March, 1869, page 163), allow me to state that benzol, as a mineral product, unquestionably comes under the act. Ether, as a vegetable product, does not; hence, doubtless, the deduction will be drawn that dealers in ether should be allowed to sell the less dangerous benzol without restriction—that, in fact, pharmacists should have been exempted from the operation of the new law. But it is the public, not chemists, who are to be educated to recognise the inflammable properties of these lamp oils and spirits, and as the public frequently, except in large towns, purchase such materials of pharmacists, exemption of the latter would have been most mischievous.

Wholesale and retail chemists and druggists will find that the act itself does not cause an unreasonable amount of trouble in requiring them to carry out its praiseworthy object of further protecting life and property from fire. Local licensing bodies, however, who are just now making regulations as to the storage of petroleum by oilmen, may unconsciously cause a vast deal of annoyance to those pharmacists who do not sell burning oils in any form, and only benzol and petroleum in little bottles under the name of glove-cleaning liquids. It is for such gentlemen, or, perhaps, the Pharmaceutical Society in their name, once for all to memorialise the Home Secretary with a view to the adoption of some rule whereby local conditions of license, which are unnecessarily irksome to Pharmacists, may be modified in the case of persons not dealing in lamp oils. Clause 6 of the Petroleum Act of 1862, which is read as one with that of 1868, specially provides this course in anticipation of difficulties such as those above mentioned.—I am, &c.,

THE PROFESSOR OF PRACTICAL CHEMISTRY TO
THE PHARMACEUTICAL SOCIETY, AND LONDON
ANALYST TO THE FIRE OFFICES.

On Phosphorus in Iron and Steel.

To the Editor of the CHEMICAL NEWS.

SIR,—In the CHEMICAL NEWS of January 29th, page 58 (*Am. Repr.*, March, 1869, page 146), is an abstract of a paper by Dr. B. H. Paul, read at the Chemical Society, on "The Connection between the Mechanical Properties of Malleable Iron and Steel, and the Amount of Phosphorus they contain," and a report of the discussion which followed it. Judging from these, it appears that the very serious fallacy upon which Dr. Paul's conclusions were based was not detected by any of the distinguished chemists who were present and took part in the discussion.

The fallacy I refer to is that of judging of the quality of steel by Mr. Kirkaldy's tests of tensile strain, &c. Had Dr. Paul carried his researches further by examining in the same manner the relative tenacity of several samples of iron (or of steel containing but little carbon), which varied only in the quantity of phosphorus they contained, he would, probably, come to a much stronger conclusion, and have asserted, as some continental chemists have done, that phosphorus, up to 0.50 per cent, improves the quality of steel. The action of phosphorus on iron and steel is to increase their hardness and their brittleness when cold, and at the same time—within certain limits—it increases their tenacity, provided they are not already highly charged with other hardening constituents. I refer here only to the tenacity as measured by a *direct and gradually applied longitudinal or axial strain*.

If the iron or steel were required for tie rods, to be subject only to a strictly axial pull, that should never occur suddenly, and that should be quite unaccompanied by vibrations, Dr. Paul's conclusion that 0.24 per cent of phosphorus would be quite a harmless quantity, and Dr. Miller's statement that 0.208 per cent of phosphorus in steel iron "is obviously not such as to injure the quality," would be quite correct, for steel iron for such a purpose would be improved by that amount of phosphorus. It is, however, quite obvious that such a combination of conditions is practically impossible.

When we consider the work to be done by the edge of a chisel, a hatchet, a sword, a graver, or a turning tool, by the teeth of a file, or a saw, or the duty of edged tools generally, it is obvious that the power of resisting a sudden, a vibratory, and a transverse shock is the property most demanded. Now this is just the property which phosphorus tends to destroy. An excess of combined carbon has a similar effect, and it is impossible to obtain hardness without a sacrifice of toughness, but this sacrifice is much greater when hardening is obtained by phosphorus than when it is conferred in an equal degree by carbon.

I have never tried the experiment, but have very little doubt that a factitious steel might be made in which phosphorus should replace (in a lower proportion) the carbon of ordinary steel, and that such a factitious steel would take a very respectable position if tried by Mr. Kirkaldy's direct tensile test *only*. It would, however, be practically useless on account of its incurable brittleness. This brittleness would be indicated by Mr. Kirkaldy's *extension test*, but not to its full practical value on account of the gradual application of the strain and the absence of vibration.

Phosphorus has another prejudicial effect upon steel, which is not in the slightest degree indicated by either the tenacity or the extension tests. I refer to the intractability of the hardness which it confers. The hardness which carbon gives to steel possesses the characteristic and invaluable susceptibility of annealing and tempering: it may, within certain limits, be modified through an infinite series of gradations, and the steel thereby may be worked by steel and adapted to the multifarious uses for which it is required. The hardness conferred by phosphorus is practically a constant quantity at a given temperature. It disappears when the iron or steel is heated, and returns on cooling; but, as far as I have at present been able to learn, the rate of cooling does not sensibly modify it.

I make the above remarks with all due deference to Dr. Miller and the other eminent chemists whose opinions on this subject I have ventured to controvert, but, as my daily work is amidst the volcanic belchings of Bessemer converters, the thumping, crashing, and earthquaking of steam-hammers, &c., I have opportunities of comparing the results of chemical analysis with the verdicts of practical trials, which are quite unattainable in any college laboratory. With all these advantages, I find the solution of such questions as the action of small quantities of phosphorus so very difficult, that I make the above remarks with some diffidence as a crude exposition of approximate knowledge.

As regards the Heaton process, which has led to this discussion, I may state that I have visited Langley Mill, and examined the work done there, on behalf of the company by whom I am employed, and although it is not my intention to here express any opinion as to the general merits or demerits of the process, I cannot refrain from saying that it appears to me that Mr. Heaton is somewhat misled on this particular subject of phosphorus—that he is not doing justice to himself in making his early trials chiefly with inferior pigs containing excessive quantities of phosphorus. Had he directed his first efforts to the production of the best quality of steel from the best quality of pigs, rather than endeavouring to compete with the Bessemer process in the race of cheapness, I believe that his results would have been more satisfactory and conclusive.

The difference in value between the best and the worst qualities of British pig-iron is about £3 per ton, while the difference in value between the best qualities of cast-steel and an ordinary Bessemer steel rail is quite ten times that amount; and I suspect that the conversion of the best pigs to steel of a given hardness would be effected with a smaller quantity of nitrate than is required for those of inferior quality. The worst sample of Heaton steel that I have analysed contains 0.24 per cent of phosphorus, the best only 0.05 per cent. They differ widely in other respects. The first sample I saw was made from an inferior pig-iron from the neighbourhood of Mr. Heaton's works, and which I had already analysed; the second was, I believe, made from a pig of very superior quality to this. The difference in value between the two products is many times greater than that between the raw materials.

Since writing the above I have received the current number of the CHEMICAL NEWS, and there read an extract from *Engineering* on this subject. You wisely disclaim any endorsement of the views there expressed. I had no intention of expressing in this letter any general opinion on the merits of Mr. Heaton's process, but this extract contains two statements which are so outrageous, that I cannot, as a lover of truth, abstain from flatly contradicting them. The first is that "*The Heaton process never produced an ounce of steel or anything resembling it.*" I have examined six samples of the product which I saw made from a pig-iron I had already analysed. The analyses of all these samples proved them to be steel, and the comparison between their composition and that of the pig-iron proved that the process was one of true conversion.

The next statement referred to is that "the furnace in which Mr. Heaton professes to melt steel at a cost for coal of 5s. per ton was never built." I was at Langley Mill on the 13th of January last, and there saw and carefully examined the furnace referred to. It was a furnace that had seen some service as proved by the vitrified surface of the flues and setting. I speak only of the *existence* of the furnace, not of its action, as I have not seen it in operation.

I am glad to see that this subject is to be taken up in the pages of the CHEMICAL NEWS which have never been used for the purposes of trading puffs or trade animosities, or that editorial pandering to advertisers in which some of the so-called scientific publications of the day have so largely indulged.

This nitrate of soda process involves some obscure chemical reactions of great scientific interest, irrespective of its commercial objects, and a description of the chemical questions it opens, in a journal which has uniformly been devoted to the faithful service of science, cannot fail to be of considerable value.—I am, &c.,

W. MATTIEU WILLIAMS.
The Laboratory, Sir John Brown and Co., Sheffield,
February 13, 1869.

The Laboratory, Sir John Brown and Co., Sheffield,
February 13, 1869.

Dr. Wallace's Lecture on the Chemistry of Sugar Refining.

To the Editor of the CHEMICAL NEWS.

SIR.—The absence of Dr. Wallace when the above lecture was read is much to be regretted. No doubt many were present who, like myself, would have been glad to have asked some questions of the author, and I think it a pity that, under the circumstances, the lecture was not postponed.

Dr. Wallace, in his remarks upon the bleaching action of ozone upon sugar, expresses a fear that this powerful agent will be found to destroy too much of the sugar to permit of its successful use. I am anxious if possible to allay this fear by stating that my researches upon this subject have convinced me that ozone, although it acts powerfully upon caramel, has, in the way in which I apply it, no action at all upon sugar. I found in one experiment that the juice of beet-roots grown in London, which marked only 6° Baumé, was perfectly crystallised when kept at a temperature of 160° F. and submitted at this temperature to the action of a current of ozonised air. Any one conversant with the difficulty of effecting the crystallisation of weak cane or beet juice, especially when operating on small quantities, will perceive that in this case the sugar would not have crystallised if it had been injuriously affected by the ozone.

As I remarked in the course of the discussion on Dr. Wallace's lecture, I do not think the ozone process is as yet sufficiently advanced to justify me in speaking with certainty upon it, but the few statements which I have made in regard to it are founded on careful experiments, and may be relied upon. In the meantime I cannot help remarking that none but those who have themselves experimented upon the process, can form any satisfactory opinion upon it, or have any right to comment on its merits or demerits.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maldenhead, Berks.
Feb. 17, 1869.

Heaton's Steel and Iron.

To the Editor of the CHEMICAL NEWS.

SIR.—In the last number of the CHEMICAL NEWS (*Am. Repr.*, April, 1869, p. 187), I find you state that neither of the bars of steel designated as 10 B or 10 C in Dr. Miller's report have been analysed, and that it remains to be proved how far the impurities in the crude steel had been eliminated by the subsequent treatment it was subjected to. In reference to this remark I beg you will allow me to state that two of the bars of hammered cast-steel, made in the experiment conducted by Dr. Miller and Mr. Mallet, were analysed by me some weeks since, and the results as to the amount of phosphorus were communicated to the Chemical Society at the meeting on the 21st of January. Those bars had been tested by Mr. Kirkaldy as to their tensile strength, and are referred to in his report as Nos. 1077 and 1082. The amounts of phosphorus found in them were '241 and '240 respectively, as stated in the CHEMICAL NEWS of the 29th of January.* (*Am. Repr.*, March, 1869, p. 146.)

I will take this opportunity of mentioning that the fallacy which your correspondent, Mr. Williams, ascribes to me, in reference to this subject, exists only in his imagination. No opinion was offered by me as to the quality of the steel, and my communication was restricted to pointing out the fact that steel of considerable tensile resistance contained an amount of phosphorus much larger than had previously been observed to exist in steel of good quality.

According to the statement of Mr. Williams, he would appear to be master of an amount of knowledge and opportunity of judging respecting this subject which do not fall to the lot of most chemists, therefore it might perhaps be regarded

* Vol. xix., p. 58.

as presumption on my part to endeavour to justify myself in regarding the tensile strength of steel as a character which the presence of phosphorus would be most likely to effect, provided the commonly received opinion as to the influence of that substance on steel be correct. For this reason I will not venture to offer any reply to Mr. Williams's letter, but will merely express my hope that, in his next communication, he may, from the abundance of his resources, confer upon chemists the benefit of somewhat more fact and less opinion.—I am, &c.,

BENJAMIN H. PAUL.

8, Gray's Inn Square.
February 24, 1869.

Spurious Guano.

To the Editor of the CHEMICAL NEWS.

SIR.—Many of your agricultural readers will doubtless be interested to learn that a material now offered for sale at the price of £11 per ton, under the attractive title of "Bi-phosphated Peruvian Guano," is not Peruvian guano at all, but a manufactured article, which, from its composition, presents a greater resemblance to superphosphate of lime, of a value less than one-half the price asked for the material which is now offered under a name calculated to convey the idea that it is even superior to true Peruvian guano, though it does not contain much more than one-third the amount of ammonia generally present in this manure, and an amount of phosphates no greater than would be present in superphosphate at about £3 per ton. The sale of trashy manures is now so extensive that this instance of the practice may be worth your notice.—I am, &c.,

BENJAMIN H. PAUL.

MISCELLANEOUS.

Optical Glass.—Messrs. Chance are now making optical glass of a density of 4.4.

Testing of Glycerin for Sugar and Dextrin.—To 5 drops of the glycerin to be tested add 100 to 120 drops of water, 3 to 4 centigrammes of ammonium molybdate, 1 drop of pure nitric acid (25 per cent), and boil for about a minute and a half. If any sugar or dextrin is present the mixture assumes a deep blue colour.—(*Polyt. Notizbl.*, 143, 1868).

Coloured Socks again!—The following advertisement appeared in Tuesday's *Times*:—"Sock and Shirt Poisoning.—A committee having been formed for the purpose of fully investigating the above subject, all persons who have suffered from wearing coloured socks or other coloured surface clothing are requested to send statements of their cases, with a portion of the garments from wearing which they have so suffered, to the honorary secretary, Emil Pohl, Esq., No. 15, Fenchurch-street, London, E.C. Medical gentlemen will also greatly oblige the committee by the particulars of cases that have come under their observation, with any comment they may have to offer."

The Heaton Steel and Iron Process.—We insert the following abridgment of an article from *Engineering*, but without endorsing the opinions there expressed. A long article on the subject is in preparation and will appear in our pages next week:—

"Careful and unquestionable analyses lately made by Professor Dr. W. A. Miller showed that the initial product of the so called 'Heaton steel process' was neither iron nor steel in any form immediately applicable to use. The crude product, by repeated heating and hammering, or rolling, could be brought to the stage of an iron of inferior quality, but probably at a cost greater than that necessary for making equally good iron from puddled bar, which of itself is cheaper than the crude product of the nitrate process. The

'Heaton process' never produced on ounce of steel, nor anything resembling it, but merely an inferior iron from which an inferior steel could be afterwards made by the usual process of melting along with carbonising substances. In saying this it should also be said that, hoping against hope, it had been widely, if not generally, wished that Mr. Heaton's representations were true, and that all his expectations would be realised. It is easy for those having no practical knowledge of a subject to place their faith in chance and the possibilities of discovery, but every inch of ground entered upon anew at 'Langley Mill' had been explored long ago, and without profit. The main gist of the paper, the first few lines of which have been quoted, is to prove that, notwithstanding an enormous amount of puffing in divers papers and periodicals, to make the process known and to set forth its immense value, it has proved a signal failure also in respect of obtaining subscribers to form a limited liability company. To some of the few shareholders in this concern has been issued a printed 'cost-sheet,' wherein it is certified that the actual results of making steel by the Heaton process, at Langley Mill, is something between £5 and £6 per ton; while every steel maker knows that this is about the cost of mere conversion of wrought-iron into cast-steel, saying nothing of the cost of the iron itself, which must be of superior quality. The furnace in which Mr. Heaton professes to melt steel at a cost for coal (not coke) of 5s. per ton was never built. It is, presumably, the wonderful furnace patented by him, which furnace could not, by any human possibility, melt steel at all, and still less, were that possible, could it melt wrought-iron, which Mr. Heaton must employ in making steel according to the common process. Were his presumed impracticable furnace capable of melting wrought-iron, were it in fact available for steel making, it would not even then have any relation whatever to the so-called Heaton process of converting pig-iron, but would constitute a distinct invention, which the Sheffield steelmasters would be glad to adopt, if they could feel perfectly assured of the truth of Mr. Heaton's statements, as to the melting of a ton of steel by some 17 cwts. of coal at a cost of 5s. It appears more and more, as might be almost *a priori*, stated by men thoroughly conversant with the metallurgical processes, approved of by a long experience, that the nitrate-steel process could never realise what has been too imprudently asserted as to its merits and technical value."

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian Buildings, on Monday evening, the 15th of February, at eight o'clock, E. C. C. Stanford, Esq., in the chair. One new member was admitted, and one candidate proposed. Mr. Gavin Chapman read a paper "On the Best Method of Utilising Sewage," which we hope to be able to give fully in an early issue.

A Curious Vocation for a Scientific Society.—Amongst the objects for which The Victoria Institute or Philosophical Society of Great Britain has been formed, is, "to give greater force and influence to proofs and arguments which might be regarded as comparatively weak and valueless, or be little known if put forward merely by individuals."

The Heaton Steel and Iron Process.—In our last number we gave a very short abstract of an article in *Engineering*. The assertions therein made appeared so bold and expressed in such strong language, that we took the precaution of prefacing our abstract in such a manner as not to mislead the readers of this paper into supposing that they received our sanction. Last week's *Engineer* contains a long letter from Mr. John Heaton, in which he refutes in the most positive manner the various statements concerning the Heaton process which have from time to time appeared in *Engineering*, and we have since been informed that two actions have been commenced against the editor of *Engineering*, so as to bring the whole matter before a legal tribunal.

Abstract of the Petroleum Acts of 1862 and 1868.—(1.) The object of these acts is the better protection of life and property from fire. (2.) The acts only relate, (a) to oils or spirits obtained from the mineral kingdom, indeed (b) only to such of these liquids as, at any temperature below 100° F., give off inflammable vapour sufficiently fast to afford a distinct flash of flame on the approach of a light. (3.) The mineral oils or spirits which thus enkindle below 100° may only be sold (wholesale or retail) when the containing vessel bears the following label:—"Great care must be taken in bringing any light near to the contents of this vessel, as they give off an inflammable vapour at a temperature of less than 100° of Fahrenheit's thermometer." (4.) Dealers in these labelled liquids may, without restriction, store them in any place that is more than fifty yards from a dwelling-house or warehouse. Before they may be kept *within* that distance either in large or small quantities (except for private use) the dealer must obtain a license from one of the following authorities:—The Court or Council of a Mayor and Aldermen; the Metropolitan Board of Works; Local Improvement Commissioners. (In Scotland) any Town Council or Police Commissioners. (In any harbour) the harbour authority. (In other places in England) the Justices of Petty Sessions. (In other places in Scotland) any two Justices of the Peace for the County. (5.) Inspectors of Weights and Measures are empowered to inspect stocks. Offenders under the act are liable to be fined.

Poisonous Dyes.—M. Tardieu, the celebrated French chemist, has made some interesting and important experiments with red stockings imported from England. After extracting the colouring matter, he introduced a certain quantity of it beneath the skin of a dog, which died in twelve hours. A rabbit similarly treated expired in eight hours, and a frog in four. Opening the animals, M. Tardieu re-extracted the red colouring matter from their bodies, and with it dyed a skein of silk. In his report, communicated to the Académie des Sciences, M. Tardieu condemns the use of the "coraline" (the mineral *sic*) poison to which the fatal stockings owe their brilliant but deceptive hue) as an article of general commerce; and recommends that the importation of red stockings from England be absolutely prohibited.—*Manchester Guardian*.

The Zirconia Light.—The Paris correspondent of the *British Journal of Photography* gives the following account of this light, with which some parts of Paris are now illuminated:—"On Saturday evening I had the pleasure of seeing the experiment of lighting, by means of the oxy-hydrogen light, as applied to towns, &c. It was the third time I had been to the Tuileries in order to see this illumination so that I could report to your readers, and I am able to report most favourably as regards the general effect. The most striking peculiarity of this light, as perfected by MM. Tessie du Mothay and Maréchal, is its perfect steadiness and freedom from flicker. It was the first remark made to me by a bystander—"How steady the light is!" The zirconia cylinders or balls are placed inside the ordinary street lamps, and the jet of mixed gases plays upon them. The light, although very brilliant, is not so painful to the eye as the electric light, and diffuses itself better. You see a globe of pure white light, about the size of a large marble, perfectly steady, and throwing its moonshine rays all around. The contrast between the lamps lit up with this light and the ordinary gas jet is very striking in two particulars, and I had the opportunity of comparing them side by side. The gaslight is yellow, wavering, and flickering, and comparatively dull; the zirconia light is white, steady, no flicker, and brilliant. I have seen many attempts to introduce the electric light for lighting streets, &c., but it is too penetrating, and the light is blinding, even at a distance, to those who are making towards it; and everything, except in the rays of this light, are in total darkness. The effect is like that of a policeman's lantern, which enables him to see all before him, but which keeps

him and his surroundings hid from all in front of him. The zirconia light is free from this defect. The question is, can the oxygen gas be procured cheaply enough, and this is asserted in the most positive manner."

Dr. Vintras.—His Imperial Majesty the Shah of Persia has conferred the honour of the Lion and the Sun on Dr. A. Vintras, Physician to the French Hospital in London, as a reward for the services which this distinguished physician has rendered to the Persian Embassy.

A Brilliant Idea.—The *Scientific American* contains the following suggestion to Baron Von Liebig:—"Justus Von Liebig, the celebrated German chemist, recently told a friend that, during the last ten years, he had received seven calls from American universities, and that twice he felt strongly tempted to go to the United States and accept there a Professorship. We trust that Liebig will visit this country and give our people the benefit of his varied stores of information; but we cannot advise him to cover up his light under the bushel of a college professorship. If the Baron wishes to make his name and fame conspicuously useful, he had better accept a position upon the editorial staff of the *Scientific American*, through whose columns he could reach and educate a hundred thousand minds each week."

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "CHEMICAL NEWS.")

Comptes Rendus. November 23, 1868.

P. A. FAVRE: "Researches on Electrolysis." F. P. LE ROUX: "On the Behaviour of the Native Chlorides of Sodium and Potassium towards some Metallic Vapours and especially towards the Vapour of Sodium." CHARRIER: "Researches on Nitrous Acid." F. FOUQUÉ: "On some Gases evolved from Petroleum Wells situated in different parts of North America." F. FOUQUÉ: "On the Composition of the Gases mentioned in the preceding paper." E. GRIMAUX: "On Cinnamate of Benzyl." G. VILLE: "On the Presence of Sulphate of Ammonia in the Lagoons of Tuscany." PINCUS: "Note on the Author's Claim to the Invention of the New Constant Battery described by Warren de la Rue and H. Müller."

November 30, 1868.

E. BROQUEL: "On Diffusion, Electro-capillary Phenomena, the Formation of Oxides, Silicates, Crystallised and Hydrated Aluminates, and on the Effects of Diffusion between Liquids which do not mix with each other." H. DEVILLE: "On the Temperature of Flames, and on its Relation to Pressure." P. DESAINS: "Researches on Obscure Colorific Spectra." BONJEAN: "Note on the Therapeutic Properties of Ergotine." FRITZSCHE: "On some New Hydrocarbons." "On a Phenomenon resulting from the Fracture of Tin when exposed to Intense Cold." STAS: "An Improved Method of Testing Silver in the Wet Way." F. JOLYET and A. CAHOURES: "Note on Crum Brown and Fraser's Memoir on the Physiological Action of the Salts of Methyltryphenium."

Poggendorff's Annalen.

No. 10. 1868.

M. WIEDEMANN: "On the Magnetism of Chemical Compounds." O. E. MEYER: "An Explanation of B. Stewart and P. G. Tafel's Experiment on the Heating of a Disc by Rotation in Vacuum." A. KUNDT: "On the Spectrum of Lightning." A. POPPE: "On the Form of the Flame of Bunsen's Burner." H. GRISSLER: "Some New Experiments on the Production of Light in Vacuum Tubes."

Annales de Chimie et de Physique.

October, 1868.

P. SCHUTZENBERGER: "Memoir on the Colouring Matters extracted from Persian Berries." A. BOBERGER: "On the Action of Sea Water on the Sheathing of Ships, and on the Methods of Investigating the same." F. KUHLMANN, JUN.: "On the Extraction of Sulphur from the Solfataras of Sicily." BERTIN: "On some New Induction Machines." E. JUNGELS: "Researches on the Chlorinated Derivatives of Benzene."

Bulletin de la Société Chimique de Paris.

November, 1868.

BERTHELOT: "On the Direct Transformation of Marsh Gas into more Condensed Carbides." "On the Hydrides of the Hydrocarbons." "On some Modes of Formation of Styrolene." E. KOPF: "On the Condensation of Hydrochloric Acid Gas in the Manufacture of Chemical Products."

Journal für Praktische Chemie.

November, 1868.

C. JESSEN: "On the Constituents and Decomposition of Starch Grains." J. LOWE: "On Catechu and Catechu-Tannic Acid." W. STRIN: "On the Colouring Matters extracted from Persian Berries." G. LUCIUS: "On the Valuation of Indigo." LIEBK: "On the Synthesis of Alcohols by Means of Chlorinated Ether." F. GOPPELSE: "On Melopiste."

NOTES AND QUERIES.

Dissociation.—In studying the phenomena of dissociation, Berthelot has discovered that sulphide of carbon is decomposed into sulphur and carbon at the same temperature at which S and C unite to form sulphide of carbon.—*Engineer.*

Utilisation of Waste Heat.—Can any of your courteous readers inform me whether the waste heat from coke ovens has ever been utilised (under patent) in the alkali manufacture, either for the raising of steam, evaporation, or in decomposing furnaces?—W. F. K. STOK.

Soap-Tablet Stamping Machine.—A subscriber would be glad to hear of the proper parties for supplying soap-tablet stamping machines and dies. He has read articles on the subject in *Muspratt*, and also in *Richardson and Watts*; but it is probable that there is something better in use than any machine described there. Who would be the likeliest engineer to supply what is required?

Action of Cyanogen on Hydrochloric Acid.—Messrs. R. Schmidt and Glutz have recently made a very beautiful experiment. When a current of gaseous cyanogen is passed into hydrochloric acid, as concentrated as possible, no colouration is observed, but after twelve hours crystals of oxamide make their appearance, and the supernatant liquid contains oxalate of ammonia. With lodydric acid the result is the same; oxamide is likewise formed, but iodine is displaced, and the liquid is found to contain hydrocyanic acid and iodide of ammonium.—*Engineer.*

Spontaneous Combustion of Silk.—M. J. Persoz has read a paper "On the Spontaneous Combustion of Silk." It is well known that silk, which, in the operations of bleaching, cleansing, &c., loses considerably in weight, can be made to fill up again, or can be charged (especially black silk) so that the material will actually gain 100 to 300 per cent in weight by this treatment. The substances usually employed for this purpose are astringents, such as catechu, gall nuts, and certain salts, especially protosulphate of iron. A charged silk of this description was found to contain 22 per cent of water, and from 17 to 115 per cent of impurities. When dried at 110° to 115°C., it took fire spontaneously as soon as air got free access to it. This effect appears to be owing to the rapid absorption of moisture, during which oxidation occurs as rapidly.

The New Petroleum Act.—According to the definition as read in the act, there can be no doubt whatever that benzol is among the substances alluded to, i.e., intended to be within the category of those substances which are rectified in the act; I have seen that a dealer in gloves has made application for a license to be allowed to keep on his premises in Regent Street 20 gallons of benzol.—Dr. A. A.

The New Petroleum Act.—In reference to the enquiry of your correspondents, "A Wholesale Firm," whether benzol comes under the operation of this act, I beg to say that the definition in clause 3 of "Petroleum," that it will be illegal to keep (otherwise than for private use) without a license, or to sell, unless the vessel containing such material have attached to it a precautionary label, includes any oil made from coal, schist, shale, peat, or other bituminous substance and any product of them giving off an inflammable vapour at a temperature of less than 100° F. Unless the naphtha of gas-tar cannot be regarded as an "oil," it would appear to be comprised in this definition as being a product of coal, and as giving off an inflammable vapour below 100° F. Benzol, likewise, though it may not be strictly an "oil," is, nevertheless, a product of coal, or, at any rate, of a bituminous substance—the tar of gas works—and therefore would appear to come under the provisions of the Petroleum Act, whether kept or sold in large quantities for the manufacture of colours and other purposes, or in smaller quantities as a material for removing grease spots, &c. Though ether and spirit of wine both give off inflammable vapour below 100° F., they are not products of any of the materials specified in the 3rd clause of the act, and therefore would not come under its provisions.—BENJAMIN H. PAUL, 8, Gny's Inn Square, Feb. 8, 1869.

Bavarian Beer.—Liebig states that 1460 quarts of best Bavarian beer contain exactly the nourishment of two-and-a-half pound loaf of bread.

Oreide.—Composition of the alloy termed "oreide":—Copper, 79.7 parts; zinc, 83.05; nickel, 6.09; iron, 0.28; tin, 0.09. This alloy, the two last constituents of which are purely accidental, resembles gold, and is used in Paris for imitating jewellery. A white alloy, very much resembling silver, consists of 69.8 parts of copper, 19.8 of nickel; 5.5 of zinc, and 4.7 of cadmium; it is a very hard alloy, which takes a beautiful polish.

Dyes from Ochella Weed.—Can you or any of your correspondents inform me what is the distinctive character of the tinctorial matters recently prepared from ochella weed, under the names orceine, orceine eriphthine, and erythrine acid? How do they differ from archil and eubear, and from each other, and how are they made?—CHROMO.

Picrate of Quinine.—Aniline Black.—Can you inform me, through "Notes and Queries," if picrate of quinine has been used as a medicine, and what dose, and what effect? Also, if there is an aniline black for cotton—I can find none in any published work. I want to find it, if the process exists.—NEW BERN.

Utilization of Waste Heat.—"W. F. K. Stock" is referred to the work "Abridgments of Specifications relating to the Preparation and Combustion of Fuel, A.D. 1620-1865," published by order of the Commissioners of Patents, 1867. (In volume in octavo. 1409 pages, price 17s. May be inspected at the library of the above-named Commissioners.

Austrian Non-Explosive Blasting Powder consists of 30 per cent of nitrate of potash, 40 per cent of nitrate of soda, 12 per cent of sulphur, 8 per cent of charcoal, 4 per cent of pit-coal, and 6 per cent of tartrate of potash and soda. This powder is explosive only when it has been rammed tight, and is then ignited by means of an explosive fusee. It is in very general use in the mining and quarrying operations in the Austrian Empire, and is far less expensive than ordinary blasting powder.

Chemistry of Food.—Charles Hunter.—This correspondent, in reducing the "grains per lb." to percentages, according to tables 3 and 4 of Dr. Letheby's lectures (see vol. xviii., page 79 and 80; *Am. Repr.*, Oct. '68, pages 191, 192), found a difference in the tables. In table 4, beef is said to contain 2301 grs. of carbon and 175 grs. of nitrogen per lb.; whereas, from table 3 giving 72 as the percentage of water, our correspondent judges that the total solids could not exceed 1820 grs.; according to his calculation, 16 is the percentage of N in albumen, 52 the percentage of C in albumen, and 48 the percentage of C in fat. Dr. Letheby has, with his usual courtesy, sent us a very full explanation, which we subjoin, for the benefit of all our readers, as well as our special correspondent. Dr. Letheby says:—"In the first place, your correspondent has not used the right numbers in any of his calculations; for the pound referred to is an avoirdupois pound of 7,000 grs., and the percentage proportions of carbon in fibrin, &c., and fat, are 53 and 77, instead of 52 and 48, while the percentage amount of nitrogen in the nitrogenous matters of meat is 15.4 instead of 16. But, even with these proportions, it is quite true that the amounts of carbon and nitrogen in table No. 4 do not in all cases correspond with the calculated proportions from table No. 3. To take the case in point, lean beef and fat beef of table 3 would have the following amounts of C and N per lb.:-

	C.	N.
	grs.	grs.
Lean beef.....	910.....	208.....
Fat beef.....	2155.....	160.....
Mean.....	1537.....	194.....

Neither of which numbers agree with those for beef in table 4; and the discrepancy arises from the circumstance, that in most cases the numbers in table 4 were obtained by actual analyses. Beef, however, like all other flesh, differs very considerably in the relative proportions of water, nitrogenous matter, and fat; and it would seem, from the proportions of carbon and nitrogen in table 4, that the beef must have contained the following percentage proportions of fat and nitrogenous matter:-

Fat.....	31.6 per cent.
Nitrogenous matter.....	16.2 "

And these proportions are not very different from the proportions which Messrs. Lawes and Gilbert found in the carcasses of half-fat and fat oxen; for, in their paper in the *Transactions of the Royal Society*, they give the following as the percentage amounts in the two cases:-

	Nitrogenous matters.	Fat.
Half-fat ox.....	17.8.....	22.6.....
Fat ox.....	15.0.....	34.8.....
Mean.....	16.4.....	28.7.....

Dr. Edward Smith says, in his "Practical Dietary," "that, on taking equal parts of beef and mutton, and a fair sample of the joints, and deducting one-tenth of the weight for bone, we find that there are 2650 grs. of carbon and 157 grs. of nitrogen in each pound" (p. 79). So that, taking all the number in the several cases, it would seem that the proportions of carbon and nitrogen per pound of meat stand thus:-

	C.	N.
	grs.	grs.
Fat beef (table 3).....	2155.....	160.....
Mean of Lawes and Gilbert.....	2155.....	177.....
Beef and mutton (Smith).....	2650.....	157.....
Mean.....	2320.....	165.....
Beef (table 4).....	2301.....	175.....

And, considering that Smith's proportions of carbon are a little too high and the nitrogen a little too low, on account of the mixture of mutton with the beef, it may be fairly assumed that the amounts which I have given for beef in table 4 are very near the truth."

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS give notice that in accordance with a suggestion of MR. CROOKES, the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, &c., for publication or reply. Their facilities of communication with MR. CROOKES render this very desirable to all persons in the United States who wish to confer with him. Address,

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Chemicus.—We know of no good work on the manufacture of pigment colours. Perhaps some correspondent could inform us if there is one.

Calcium.—A table of equivalents and a rule-of-three sum will answer the question as well as we could.

J. T. S.—The letter was unavoidably left standing over for some weeks, owing to the great press of matter.

J. Sutherland.—We cannot give the information at present, but will insert the substance of your query.

J. W.—1. Doubtless there would be a little more demand for sodium at 3s. per pound than there is at present; but we do not think it would be worth any one's while to make it for that price, were the demand double what it is now. 2. Messrs. Roberts, Dale, and Co. hold the patent—apply to them. 3. The patent itself can be procured from the Patent Office for a few pence.

G. E. D.—1. Either the conversion of the benzol was incomplete, or the liquid you experimented upon was not benzol. There is no difficulty in making nitrobenzol from good materials. 2. As you are a student of chemistry, take our advice, and leave atoms and molecules alone for the present. Nobody knows how the atoms are arranged in elements of different atomicities. Graphic formulae, diagrams, &c., are only artificial aids to fix certain properties of bodies on the memory; but no one intends them to represent the architectural plan and elevation of the body. Avoid theory; stick to experiment. 3. A compound, NH_4 , is said to have been isolated. See the article, "Ammonium," in Watt's "Dictionary."

Chemicus.—This correspondent, who wanted to know of a good work on pigment colours, is informed that a letter is waiting for him at our office.

F. E. S. Jerningham.—We regret our inability to furnish information respecting Winter's electrical machine.

Knife Edge.—An angle of 30 degrees appears a little too acute for an agate knife edge; we have seen them as obtuse as 60°, and work very well.

H. H. G.—Hopkin and Williams.

G. E. D.—You seem to have read nearly all the books we could recommend.

D. John.—The product of one distillation at 100 C., will be very far from pure benzol. The benzol should be separated from the naphtha by fractional distillation, and then purified by freezing.

H. How.—The article received with thanks; it shall be inserted in an early number.

Communications have been received from Dr. R. Angus Smith, F.R.S.; J. J. Lish; L'Abbé Moigno; Dr. Adriani; J. J. Griffin and Sons; Dr. Röhrig; J. Spiller; Prof. Heaton; W. H. Perkin, F.R.S.; E. R. Tatlock; W. F. R. Stock; Stevens, Bros.; C. C. Williams, F.R.S.; J. Watson; J. Sutherland; J. T. Sprague; J. Heywood; Drogheda Chemical Manure Works (with enclosure); Longmans and Co.; Dunn and Co.; Tennant and Co.; Dr. S. Muspratt; J. T. Bouck (with enclosure); W. Little; F. S. Jerningham (with enclosure); W. Blythe (with enclosure); Calvert and Co. (with enclosure); Demuth and Co.; H. Smith; F. A. Pooley (with enclosure); W. Hunter (with enclosure); W. E. Bickerdike (with enclosure); C. Hunter; L'Abbé Moigno; A. Steel; J. Rothschild; Professor H. How, Nova Scotia; D. John; R. Berry; H. Noyes; J. J. Lish; C. G. Williams, F.R.S.; J. Spiller; Professor Wanklyn; Professor Heaton; H. Hudson; R. E. Tatlock; Professor Brazier; Professor Atfield; W. T. Suffolk; Dr. E. Fleischer, Dresden; F. E. S. Jerningham; C. Hunter; J. Barrow; Dr. Paul; Miss Lydia Becker; W. Neill and Son; A. Maurice; W. Mackenzie; W. White; G. H. Brown; A. Carter (with enclosure); The Runcorn Soap and Alkali Co. (with enclosure); Mawson and Swan; J. Simpson; L. Demuth and Co.; J. W. Lumley; N. Lincoln; J. F. Dickson; J. M. Duluth; T. De La Rue and Co.; Professor Hinrichs, Iowa City, U. S.; Dr. Muter (with enclosure); W. Cass; W. H. Perkin, F.R.S.; F. Sutton, F.C.S.; H. D. Collingwood; Lumsden and Son (with enclosure); B. Wheeler (with enclosure); T. Geeves; J. and W. Rickard (with enclosure); Burnard, Lack, and Co. (with enclosure); Dr. Andrews (with enclosure); Albright and Wilson (with enclosure); and Dr. Odling, F.R.S.

Books Received.—"Annual Report of the United States Patent Office for the year 1866," from the Honourable the Commissioner of Patents, Washington. "Causeries Scientifiques, Découvertes et Inventions, Progrès de la Science et l'Industrie. Ouvrage orné de 72 vignettes et d'une Chromolithographie, Huitième Année, 1868." Paris: J. Rothschild, Editeur. "The Law to Regulate the Sale of Poisons within Great Britain." By William Flux. London: John Churchill and Sons. "More Light: a Dream in Science." London: Wyman and Sons. "Report of the Manchester Scientific Students' Association for the year 1868." Manchester: Cave and Sever; Edwin Slater. "Braithwaite's Retrospect of Practical Medicine and Surgery." Part LVIII, January. Uniform American edition. New York: Townsend and Adams. American Reprint of Chemical News. February.

AMERICAN SUPPLEMENT.

New York, April, 1869.

The New French Dictionary of Chemistry.

THREE parts of this work are now before us, and they carry it 480 pages, beginning with Abichite and ending with Atropine. The work is not planned on so great a scale as Watts' Dictionary, and the style of writing is not so precise and compact as that of the latter. Yet it is to be prepared by some of the most competent of the French authors, and there will be good opportunities to correct the deficiencies of the English work, as well as to add the latest developments of the science. It is a very great advantage to the editors to have so perfect a model as Watts' Dictionary to guide them and to suggest improvements.

We expect to find a great deal worth reading, especially in the articles on the various departments of chemical philosophy, inasmuch as French chemists are always theorists, and as Wurtz, Naquet, and some others of the editors are recognized as leaders.

We believe that we cannot do our readers a greater favor touching this work than to give as a sample of it the following introduction of its article on Atomicity:

"Atomicity.—Thus we name the capacity of combination of atoms. We know that—

1 atom of chlorine combines with 1 atom of hydrogen.	
1 " oxygen " 2 atoms "	
1 " nitrogen " 3 " "	
1 " carbon " 4 " "	

These simple bodies differ from each other in their capacity of combination for hydrogen, and this capacity is measured by the number of atoms of hydrogen which they are able to fix. We see, then, that capacity of combination is not synonymous with affinity. The energy with which a body is combined with another body is independent of the faculty which it possesses of attracting one or several of the atoms of the latter.

"The first is affinity, the second atomicity: both are manifestations of the chemical force.

"Affinity is measured by the quantity of *vis viva* which is transformed in the effect of combination, and is manifested as heat.

"Atomicity is measured by the number of atoms of hydrogen, or of an analogous element, which a given body can fix. The atoms of chlorine and those of hydrogen are so made that one atom of the first attracts always one atom of the second. The force with which it attracts is affinity; the virtue of contenting itself with a single atom is atomicity. In the latter respect the atoms of chlorine and of hydrogen are of the same value: one atom of the one is fixed by one atom only of the other. The force which resides in them is a powerful force, but simple. The force which resides in an atom of oxygen is powerful also, but of a more complex nature, since it is able to attach two atoms of hydrogen, when an atom of chlorine can attract but a single one.

"Here, are atoms of chlorine; as they come into the sphere of activity of the atoms of hydrogen, an atom of the one is precipitated upon an atom of the other: there is a combination. There, are atoms of oxygen which penetrate into the sphere of activity of atoms of hydrogen; an atom of one attracts two of the other: there is a combination. Thus we demonstrate, in the force which attracts the atoms of one body towards the

atoms of another body, two distinct things, namely: 1st, its intensity; 2d, its action, simple or multiple. These two manifestations of the chemical force are independent of each other. In fact, the energy of affinity is not a measure of the degree of atomicity.

"Chlorine attracts hydrogen with more force than carbon, and yet one atom of carbon can unite itself with four atoms of hydrogen, while an atom of chlorine takes but a single one of hydrogen.

"Atomicity is, then, that peculiar property of an atom of attracting a number greater or less of other atoms. It is its value, or, as we say, its capacity of combination in relation to those other atoms."

The article, on the introduction as above, proceeds to consider the measure of atomicity, atomicity as a means of classification, atomicity considered in chemical reactions, and, finally, atomicity as a means of determining the manner of the arrangement of atoms in compounds. The whole article covers ten pages of the dictionary, and our quotation comprises a little less than half a page of it.

The Numerical Relations of Atoms. New Elements Predicted.

In the following table the elements are arranged in two columns, according to their even or odd atomicities, and at the same time observing the order of their atomic numbers:

Artiads.		Perissads.	
		Hydrogen,	1
Glucinum,	9.3	Lithium,	7
Carbon,	12	Boron,	11
		Nitrogen,	14
Oxygen,	16	Fluorine,	19
Magnesium,	24	Sodium,	23
Aluminum,	27.4		
Silicon,	28	Phosphorus,	31
		Chlorine,	35.5
Sulphur,	32	Potassium,	39.1
Calcium,	40	Vanadium,	51.4
Titanium,	50		
Chromium,	52.2		
Manganese,	55		
Iron,	56		
Nickel,	58.8		
Cobalt,	58.8		
Yttrium,	61.7		
Copper,	63.4		
Zinc,	65.2		
Indium,	72		
		Arsenic,	75
Selenium,	79.4	Bromine,	80
Strontium,	87.6	Rubidium,	85.4
Zirconium,	89.6		
Cerium,	92		
Lanthanum,	93.6	Columbium,	94
Molybdenum,	96		
Ruthenium,	104.4		
Rhodium,	104.4		
Palladium,	106.6	Silver,	108
Cadmium,	112		
Erbium,	112.6		
Tin,	118	Uranium,	120
		Antimony,	122
Tellurium,	128	Iodine,	127
Barium,	137	Cesium,	133
Tungsten,	184	Tantalum,	182

Artiads.		Perissads.	
Didymium,	195		
Iridium,	196		
Platinum,	197.4	Gold,	197
Osmium,	199.2		
Mercury,	200		
Lead,	207	Thallium,	204
		Bismuth,	210
Thorium,	231		

An inspection of this table shows that the elements are brought into something like a natural relation with each other. Where the atomic numbers agree in the two columns, there is a still further agreement in the corresponding elements; the element of even atomicity is paired, or mated, with an element of odd atomicity. Probably for each column there is a progression of properties from the top to the bottom in the order and in the proportion of the numbers, and the discovery of such properties is a fair and open problem. Also the columns readily break up into smaller columns or groups, some of which have been recognized for a long time. Below are examples:

1.			
Lithium,	7	Glucinum,	9.3
Sodium,	23	Magnesium,	24
Potassium,	39	Calcium,	40
Rubidium,	85.4	Strontium,	87.6
Cæsium,	133	Barium,	137
2.			
Fluorine,	19	Oxygen,	16
Chlorine,	35.5	Sulphur,	32
Bromine,	80	Selenium,	79.4
Iodine,	127	Tellurium,	128

And we add some of the most striking of the remaining couples:

Silver,	108	Palladium,	106.6
Gold,	197	Platinum,	197.4
Lead,	200	Thallium,	204

The peculiar relationship of the artiads and perissads in (1) is very striking. On one side are all the metals of the known alkalies, and each is paired with a metal of a well-known alkaline earth. Moreover, on each side there is a plain progression of properties in the order of the atomic numbers.

The standing out, unpaired, of hydrogen, nitrogen, phosphorus, arsenic, antimony, and bismuth is very noticeable, for these are the only unmated elements of the perissad column. What is the explanation? Can we bring them into relation with the fluorine and oxygen group?

But there are many artiads which have no corresponding perissads, and it is very noticeable that so many of these occur together. From titanium 50 to selenium 79.4 there is no pairing.

Is it possible that these vacant places are to be filled by the discovery of new elements? That this question has a fair foundation will be concluded when it is remarked what a very appropriate place had been reserved for rubidium and cæsium at the side of strontium and barium. If the theory here suggested is tenable, we may continue the search for new elements with confidence, and we may know in advance something of their nature and properties. We may, for example, for more alkali metals, and especially such as will place between potassium and rubidium, between rubidium and cæsium, and below cæsium.

HO or H₂O. The Atomic Notation.

DALTON'S atomic theory implied exact numerical relations between the atoms of different kinds of matter. The theory having been accepted, there was no labor more urgent among chemists than the determination of the atomic numbers, for under these numbers lay untold treasures of knowledge. From that time forward the atomic theory and the atomic numbers have become and will ever remain the foundation of our science and our art of chemistry. Where would be our chemistry without them?

Dalton made the first effort to determine the relative weights of some of the atoms. But Dalton was a philosopher, and he had a great work as reformer and instructor to perform; he had not the time nor the aptitude for nice chemical analyses. His object was to illustrate and enforce his atomic theory, and the numbers he gave were sufficiently near the truth for that.

Shortly afterwards the great Berzelius, than whom perhaps no one who has ever lived was better endowed by nature and education for the service, commenced a systematic course of experiment and analyses, with the view of determining with extreme exactness the true atomic numbers. This work occupied the best part of his long and industrious life. Berzelius' table of atomic numbers is one of the noblest and most enduring monuments which the patience and skill of a single man has ever reared.

Dalton supposed an atom of water to be made up of one atom of hydrogen and one of oxygen. He used properly all the criteria of judgment he had, and made a mistake. In his time it was possible to determine, with considerable exactness, the relative weight of hydrogen and oxygen in water, but there were not sufficient data for determining the ratio of the number of their atoms:—It was known that the total hydrogen was to total oxygen, by weight, as 1 : 8; but there was then no sufficient reason for fixing the number of the atoms of each. Dalton's atoms, like his analytical data, were therefore only temporary or provisional, and to be set aside as soon as the truth could be more exactly stated. Berzelius satisfied himself that the atom of water is composed of three atoms, viz., two of hydrogen and one of oxygen, and so he taught. His criteria of judgment were good; in fact, nearly all that we use at the present day. But his critics, especially Gmelin, assailed his reasoning with vigor, and they prevailed. To-day this truth, crushed to earth, is risen again in new strength, and hereafter it will take its place among our most impregnable doctrines.

The true atomic constitution of water being established, we respectfully suggest to the teachers that they are unwise and unsafe in persisting in teaching a false doctrine. Why not cut adrift, with a single effort, all the text-books which are not based on the true atomic notation? The chemical world have been searching for sixty years after truthful atomic numbers, and now that we have them, why should we hesitate to adopt them?

The atomic notation lies at the foundation of the modern chemical philosophy. When it is accepted and understood, the doctrine of atomicity and the overthrow of the dualistic theory follow without an effort. In the light of the atomic notation, what was mystery beyond the scrutiny of the greatest intellects becomes simple facts which can be taught to children.

There appears to be a notion prevailing among those who have not studied the new chemical philosophy, that

the new notation-table is not so simple as the old, and that the new philosophy in detail is quite abstruse. The notion is far from being just and true. Those who have developed the new philosophy, not always seeing their path clear, have sometimes gone astray, and have magnified the importance of little things, so that to those looking on, there appeared a great deal of confusion and uncertainty. There was a great contest, and in it the combatants and the interests involved were often obscured by the smoke. Moreover, some of the triumphant reformers are still so generous and chivalric that they do not demand the complete submission of their late antagonists; they strive hard to find apologies for the old numbers and for dualism. They find the old numbers chemical equivalents, and speak very respectfully of what they call the equivalent notation, as if it never pretended to be anything else and as if it is remarkable that it should be an equivalent notation, although any notation founded on chemical analysis is of necessity equivalent. The fact is, the old notation as an equivalent notation has no point of advantage over the new; the atomic notation is the nearest realization of what is desirable in an equivalent notation.

During the last twenty years the philosophy of the physical sciences has been stirred up from its very lowest depths. There has been a revolution in ideas, and it ought to be recognized now in all its consequences. The reconstruction must proceed; woe to him who stands in its way!

Cracking, again.

CRACKING of petroleum seems to be a subject very irritating and provocative of hard words. Dr. Hirsch naturally is not content with the flagellation he received from Prof. Peckham, and asks to be allowed to put in a few words. He sends us for publication an article which, on account of its length, we are forced to decline. In it he shows that his language and his ideas have been misunderstood and misrepresented; in fact, he does not materially on the main question disagree with Prof. Peckham. His first article was intended to take for granted things which he was accused of denying; it discussed points in detail which never before had been touched. In our judgment, Dr. Hirsch makes out a pretty good case. All parties are to be congratulated at the termination of a dispute by the discovery that it had very little foundation. We suppose now all crooked words are withdrawn, and that they were never used except in a Pickwickian sense.

As a sample of Dr. Hirsch's rejoinder, we present the following extract, which covers a question alluded to in the letter of Prof. Peckham which appeared in our last:—

"The third rule is called correct, and, like the fourth, not criticised; I therefore proceed to the fifth, which reads thus: 'The difference of gravity between the oil distilled and the distillate is in direct proportion to the quantity of water produced during the process.'

"This rule is referred to as 'extraordinary, because it presumes the transmutation of one element into another, if water can be produced by the distillation of volatile hydrocarbons with exclusion of oxygen.'

"But this exclusion of oxygen could only originate in the fertile brain of Mr. Peckham, as surely no such assertion can be found in my paper on the subject. It is true, I did not detail the manner in which the oxygen gains access to the boiling oil, because this is a matter too well known to all practical distillers. But

since the above criticism shows that not everybody is a distiller, even of those who write on the subject, I shall attempt to explain.

"During the operation of cracking, volumes of oil-vapors fill up the upper portion of the still. They rise to the top, where by radiation, or by other means for cooling, they are condensed, the consequence of which condensation is a partial vacuum. At the same time the fire is kept low, the heat is insufficient to fill instantly the vacuum created with fresh vapors, when that space will at once be occupied by air, which enters through the condenser, generally a worm.

"If, as is usual, a U-shaped tube, called a gas-trap (and used to aid the separation of the gaseous from the liquid distillate), forms the end of the worm, the liquid filling up that part of the tube is continually drawn into the condenser, producing the noise peculiar to the suction of a pump, thus keeping time to the almost regular pulsations of the oil in the still (the rise and condensation of the vapors), and marking plainly the entrance of air into the apparatus, the jolting noise in which soon reveals the presence of an abundant supply of water.

"The more, as stated in the other rules, the top of the still is cooled, the greater will be the vacuum and the more often and abundant will be the access of air and the consequent formation of water. A great reduction in the gravity of the distillate is *always* accompanied by the production of water and the phenomena described.

"If I do not assume a wilful misconception of my article, especially of this fifth rule (and I have no cause to do so), I am at a loss how to express my opinion of the criticism any better than by the following anecdote, which I read many years ago:—

"During a heavy rainshower, a man hurrying to a place of shelter noticed a person sitting on a curbstone, exposed to the vehemence of the storm, while he had both his boots pulled off. 'What are you about?' exclaimed the man astonished. 'Oh,' replied the other, coughing, 'my lungs are very feeble, and my physician strongly urged it upon me always to change my stockings the moment wet weather sets in. As I mean to follow his advice *strictly*, I don't even wait until I get home, but change them now, from my right foot to the left and from my left I put the stocking on my right foot.'

"I beg leave to state, that I for my part don't write for such patients."

Dead Classics vs. Living Science. The New Education.

THE overseers of Harvard College have nominated Charles W. Eliot for President of the University, and will submit his election to a future meeting of the corporation. Mr. Eliot is a son of Hon. Sam. A. Eliot, and at present is professor of analytical chemistry and metallurgy in the Massachusetts Institute of Technology; he is one of the authors of Eliot and Storer's Manual of Chemistry, and contributed to the *Atlantic Monthly* for February a striking article, entitled "The New Education," in which he advocates a greater prominence of the physical sciences in the college curriculum. The election will probably test the strength of the corporation on the question of dead language classics vs. modern science. The fact that such a question has come up so prominently in our most ancient seat of learning is surely significant. Mr. Eliot is still a young man, being

only thirty-eight years of age, and if he is defeated now, he can hopefully bide another time. Union College, which we believe was the first orthodox seminary of learning which allowed its students to substitute modern science for Greek and Latin, is also looking for a president. The choice, which shall be made by these institutions, is of the very highest moment to the scientific interests of America.

The New York Lyceum of Natural History.

"PROFESSOR — sharply ridiculed the absurdity of New York in its scientific aspects. Efforts had been made to establish a Lyceum of History; a building was erected, which, on account of a paltry mortgage, was subsequently given up, and after this the collection was packed up and moved from one place to another, till finally it was destroyed by fire; 'and now (said he) I have here on view its remains: the head of an old mammoth, and some specimens of crystal quartz—this is the end of what was the principal collection in New York.'"

The above is extracted from a popular monthly magazine, and is calculated to be harmful to one of the most worthy of American societies. The Lyceum has been in healthy existence for more than fifty years. It has included among its members all, or nearly all, the active promoters of science residing in the city since its origin. At present there are over three hundred resident members, and about as many more corresponding members. Its committee, or section on chemistry, at present numbers fifty-six. The meetings of the Lyceum are weekly, and are well attended and spirited. The transactions are regularly published, and are exchanged with learned societies all over the world. It has a large and very valuable library, and great additions are constantly being made to it. It is the only society in the city for the promotion of natural history and the physical sciences, and is believed to combine nearly all the sincere love and zeal for these sciences which has been discovered here.

It is, indeed, true that the society is not rich in money endowments. But there are those who honestly believe that the possession of money would bring serious embarrassments to the carrying on the legitimate objects of the society. Riches often prove the ruin of societies as well as individuals. Natural history collections and fine apparatus and buildings are very desirable for popular instruction, but they are of little use to a society of original investigators. Pecuniary affairs need to be managed by business men, and they might prove only a snare and a pitfall to those who have not the aptitude to manage them. New York ought, by all means, to have great scientific collections, and in due time we think she will have them in the Central Park, and they will properly be created and managed by the business men.

NEW PUBLICATIONS.

HOW TO READ CHARACTER. A new Illustrated Hand-Book of Phrenology and Physiognomy, for Students and Examiners. Pp. 191. New York: Samuel R. Wells.

THE mantle of the formerly well-known publishing firm, Fowler & Wells, seems to have fallen on the worthy and ample shoulders of Mr. Wells. The publications of the establishment will therefore continue to be first-class, so far as regards the mechanical and material part. The phrenology—science of the mind—of this book is the bumpology of our youth: it has more lives than a cat.

FIRST PRINCIPLES OF CHEMICAL PHILOSOPHY. Part First. By Josiah

P. Cooke, Jr., Erving Professor of Chemistry and Mineralogy in Harvard College. Pp. 196. Cambridge: Welch, Bigelow & Co. THIS is the most complete, exact, and systematic exposition of modern chemical theories which, up to the present time, has come to our notice. It is admirable for a college text-book.

HYSTERIA. Remote Causes of Diseases in General. Treatment of Disease by Tonic Agency. Local or Surgical forms of Hysteria, etc. Six Lectures delivered to the students of St. Bartholomew's Hospital, 1866. By F. C. Skey, F.R.S. Second American Edition. Pp. 110. New York: Townsend & Adams.

THESE lectures are so lively and so plainly spoken, that they are good reading even for the non-professional.

ANNUAL OF SCIENTIFIC DISCOVERY; or, Year-Book of Facts in Science and Art for 1869, etc. Edited by Samuel Kneeland, A.M., M.D. Pp. 377. Boston: Gould & Lincoln.

THIS volume is adorned with a fine portrait of Professor James D. Dana. It maintains the well-known high character of the series.

ATROPIA: its Chemical, Physiological, and Therapeutic Action; together with Experiments instituted to Ascertain its Toxicological Properties. By Samuel R. Percy, M.D., Professor of Materia Medica, etc. Pp. 242 to 286 of the *N. Y. Medical Journal* for Dec., 1868.

THIS is an essay for which was awarded the prize, for the years 1867-8, of the Alumni Association of the Medical Department of Columbia College.

THE WESTMINSTER REVIEW, January, 1869. **THE EDINBURGH REVIEW,** January, 1869.

THE copies before us are the republications of the Leonard Scott Publishing Co., 140 Fulton St., New York. The Edinburgh contains an essay on the adulteration of food, and its customary *résumé* of scientific intelligence.

THE AMERICAN JOURNAL OF SCIENCE AND ART, March, 1869.

THE articles in this number of special interest to chemists are: 1. On a new Salt containing 1 in, Cesium, and Chlorine. By S. P. Sharples. 2. Upon the Atomic Volumes of Liquids. By F. W. Clark. 3. On the Wave Lengths of the Spectral Lines of the Elements. By Wolcott Gibbs. 4. On the Condition of our Knowledge of the Processes in Luminous Flames. By E. W. Hilgard. 5. Notices of new Meteoric Irons in the United States. By C. U. Shepard. 6. On Nitric Acid. By J. W. Johnson. 7. On a Modified Form of the Nitrate of Silver Test for Arsenic Acid. By Charles E. Avery. 8. Notices of Papers in Physiological Chemistry. By Geo. F. Barker. 9. A new Meteoric Iron. "The Wisconsin Meteorites"—with some remarks on the Widmanstätten Figures. By J. Lawrence Smith.

BREVITIES.

THEODORE STRONG, an eminent mathematician, died February 1, at New Brunswick, N. J., at the age of 79. He graduated at Yale College in 1812. He was at one time a professor at Hamilton College, and subsequently at Rutgers College. He was the author of many original papers on mathematical subjects, and at the time of his death a treatise by him on the differential and integral calculus was in press.

JOHN CASSIN, an eminent ornithologist, died in Philadelphia, January 10, at the age of 57. He devoted all his leisure of thirty years to the study of his favorite science.

THE *American Journal of Science* announces that "a gynecological society has recently been instituted at Boston, having for its objects the advancement of gynecic science and art, and their due recognition both in Boston and throughout the country." We suspect that this new science and art pertains somehow to women.

WE have before us, the work of Thos. Gaffield, Esq., some very beautiful direct-contact photographic prints of ferns. The ferns were artistically arranged within the outline of a wreath and a cross, and the effect is very pleasing.

WITHIN a few miles of New York city, it is said, there is an extensive nitro-glycine factory. A few weeks since a cart-load of the infernal preparation, the packages being marked "gasoline," was joited through the heart of the city, and at another time a quantity sufficient to demolish the city was dumped on the Battery. Such reckless proceedings ought to be declared a felony by law.

TO CORRESPONDENTS.

A. G. V., of N. Y.—Gas lime, as you remark, has a pretty offensive smell, and the heaps of it sometimes seen about gas-works are nuisances. But the foul gas and volatile compounds which get into the air on opening the boxes are the main source of offence in the cities. The expense and trouble of ventilating the line before opening is insignificant. * * * The iron process is increasing in favor.

G. O. V., of O.—The patented processes for rendering kerosene "non-explosive," by means of chemical agents, number a score or more. We do not know of one of them which is worthy of a thought.

S. M. R., of Conn.—The profitable manufacture of bleaching powder requires a combination of circumstances which has not yet been realized in America. You are mistaken in supposing that there are any secrets, a knowledge of which is essential.

B. E. S., of Mass.—Oreide is simply a very good brass. The golden color can be got by alloying any white metal with copper.

AMERICAN DRUGGISTS' PRICE-CURRENT-NEW YORK.-JOBBER'S PRICES.

DRUGS AND CHEMICALS.

[illegible]

Flowers, Rosemary.....	per lb	to 70	Lactearium.....	per oz	to 75
Tillae.....	per lb	to 70	Lead Acetate, pure.....	per lb	to 1 00
Violet.....	per lb	to 68	Licorice Paste, solid.....	per lb	to 48
Fusel Oil, purified.....	per lb	to 9 25	Sicily.....	per lb	to 80
Ferro-Phosphorated Elixir of Calisaya.....	per doz	to 12 00	Calabria.....	per lb	to 48
Barb, Hazard & Caswell's.....	per grs	to 144 00	Imitation.....	per lb	to 27
Gamboge.....	per lb	to 1 85	Barraco.....	per lb	to 48
Gelatine French Pink.....	per lb	to 1 45	P. 8.....	per lb	to 50
Gelatine, White French.....	per lb	to 1 00	Lime, Carbonate, Precipitate.....	per lb	to 23
Cox's.....	per doz	to 2 50	Hypophosphite.....	per lb	to 3 75
Ginger, Jamaica, bleached.....	per lb	to 80	Iodide.....	per lb	to 8 50
Ginseng.....	per lb	to 85	Phosphate, Precipitate.....	per lb	to 40
Glauber Salts.....	per lb	8 to 4	Sulphite.....	per lb	to 21
Glycerine, common.....	per lb	to 35	Lime Juice.....	per gal	to 80
concentrated.....	per lb	to 50	Lint, Taylor's.....	per lb	to 1 80
"Rowers".....	per lb	to 80	Lapis Calaminaris.....	per lb	to 8
"Price's".....	per lb	to 1 15	Laurel Berries.....	per lb	to 13
Glycerole Hypophosphite.....	per lb	to 1 75	Leaves.....	per lb	to 13
Grains D'Ambrette.....	per lb	to 60	Liquid Styraz.....	per lb	to 60
Parafise.....	per lb	to 80	Long Pepper.....	per lb	to 90
Gum Acroides.....	per lb	to 24	Lunar Caustic, pure.....	per oz	to 1 80
Amber.....	per lb	to 50	67 per cent., N. 8.....	per oz	to 90
Ammoniac.....	per lb	60 to 75	Lycopodium.....	per lb	to 70
Arabic, Turkey, sorts.....	per lb	to 55	Magnesia Carbonate.....	per lb	to 45
1st picked, Trieste.....	per lb	to 95	Calcined.....	per lb	95 to 1 20
2d ".....	per lb	to 75	ponderous.....	per lb	to 1 80
3d ".....	per lb	to 55	Citrate.....	per lb	to 1 75
Barbary.....	per lb	to 40	Sulphite.....	per lb	to 1 20
Assafetida.....	per lb	to 55	Manganese, powdered.....	per lb	to 8
Benzoin, common.....	per lb	to 90	Saxony.....	per lb	to 13
prime.....	per lb	to 1 00	Manna, small flake, '67.....	per lb	to 1 85
white marbled.....	per lb	to 1 10	large flake, '67.....	per lb	to 2 50
Copal, Acra.....	per lb	to 30	sorts, new.....	per lb	to 1 45
Benguela.....	per lb	to 30	Matico Leaves, true.....	per lb	to 50
Kowrie.....	per lb	to 45	Mercury.....	per lb	to 85
Damar, Batavia.....	per lb	to 60	cum Oreta.....	per lb	to 58
Singapore.....	per lb	to 55	Magnesia.....	per lb	to 1 23
Elemi, Aromatic.....	per lb	to 55	Cyanuret.....	per lb	to 5 80
Euphorbium.....	per lb	to 25	Sulphuret.....	per lb	to 80
Galbanum.....	per lb	to 1 10	Mercurial Ointment (1/2 M).....	per lb	to 65
strained.....	per lb	to 1 40	(1/2 M).....	per lb	to 55
Gedda.....	per lb	to 30	Morphia Sulphate.....	per oz	to 13 50
Guaiaacum.....	per lb	50 to 65	Acetate.....	per oz	to 13 50
strained.....	per lb	to 70	Muriate.....	per oz	to 13 50
Kino.....	per lb	to 1 00	Valerianate.....	per oz	to 15 00
Mastic.....	per lb	to 4 25	Musk, true.....	per oz	to 16 00
Myrrh, Turkey, powdered.....	per lb	to 75	in grain true.....	per oz	to 33 00
Olibanum.....	per lb	to 80	Nux Vomica.....	per lb	to 13
tears.....	per lb	to 40	Oil, Amber, Crude.....	per lb	to 60
Sandarac.....	per lb	to 65	Almonds (Expressed) Allen's.....	per lb	to 90
Shellac, Campbell's D. C.....	per lb	to 60	Essential, Allen's.....	per lb	to 24 00
Garret.....	per lb	to 55	Anise.....	per lb	to 4 00
No. 2.....	per lb	48 to 50	Bergamot.....	per lb	6 00 to 7 00
Native.....	per lb	48 to 50	FF, new crop.....	per lb	to 6 50
Senegal.....	per lb	to 50	Bergamot, Donner's.....	per lb	to 7 00
Tragacanth, common.....	per lb	to 50	Bergamot, —Sanderson's.....	per lb	to 7 00
flake.....	per lb	1 80 to 1 50	Cade.....	per lb	to 1 00
flaky sorts.....	per lb	to 60	Cajeput.....	per lb	to 9 00
Harlem Oil, Dutch.....	per doz	to 50	Camphor.....	per lb	to 1 75
Hoffman's Anodyne.....	per lb	to 48	Caraway.....	per lb	to 2 75
Hydriodate Potash, Atkinson's.....	per lb	to 5 40	Seed.....	per lb	to 5 50
Conrad's.....	per lb	to 5 30	Cassia.....	per lb	to 4 00
Hyoscyami Leaves.....	per lb	to 28	Cinnamon, true.....	per oz	to 1 50
Hypophosphite Ammon.....	per lb	to 8 75	Citronella, prime.....	per lb	to 2 75
Iron.....	per lb	to 8 50	Copaiwa.....	per lb	to 8 50
Lime.....	per lb	to 8 75	Copaiva.....	per lb	to 8 00
Manganese.....	per lb	to 14 00	Croton.....	per lb	to 4 00
Potash.....	per lb	to 8 75	Cubebs.....	per lb	to 4 50
Soda.....	per lb	to 8 75	Gummin.....	per lb	to 10 00
Iceland Moss.....	per lb	10 to 12	Fennel.....	per lb	to 8 00
Indian Hemp, true.....	per lb	to 1 60	Geranium.....	per lb	13 00 to 25 00
Insect Powder, true.....	per lb	to 1 10	Chris.....	per lb	to 18 00
Iodine, Resublimed.....	per lb	to 6 75	Prepared.....	per lb	to 25 00
Crude, in bulk.....	per lb	to 6 50	Turkish.....	per lb	14 00 to 18 00
Irish Moss.....	per lb	to 10	Jessamine.....	per lb	to 3 50
Iron, Alum.....	per lb	to 1 60	Juniper.....	per lb	to 1 90
by Hydrogen.....	per lb	to 2 80	Berries, true.....	per lb	to 3 50
Carb. Proto.....	per lb	to 45	Lavender, Garden, forte.....	per lb	to 1 65
Precip.....	per lb	to 25	fine.....	per lb	to 1 85
[Citrate and Ammonia.....	per lb	to 1 45	Flowers, Chris, No. 1.....	per lb	to 3 75
Magnesia.....	per lb	to 1 85	Lavender Spike.....	per lb	to 1 00
Quinine.....	per lb	to 10 00	Laurel, Expressed.....	per lb	to 90
Strychnine.....	per lb	10 00 to 12 50	Lemon, Donner's.....	per lb	to 4 50
Hypophosphite.....	per lb	8 40 to 8 50	Lemon, —G. R. & Co's.....	per lb	to 4 75
Iodide.....	per lb	to 8 25	—Sanderson's (new).....	per lb	to 4 75
Syrup.....	per lb	to 80	Lemongrass, —Winter's.....	per lb	to 7 00
Lactate.....	per lb	to 8 25	Mace, Expressed.....	per lb	to 2 50
Phosphate, Precipitate.....	per lb	to 67	Marjoram.....	per lb	to 1 75
[Pyrophosphate.....	per lb	to 1 15	Myrrhane.....	per lb	to 3 00
Syrup.....	per lb	to 65	Neroli Bigarade.....	per oz	to 5 00
[Sesquichloride.....	per lb	to 1 45	Chris.....	per oz	to 5 00
Sol.....	per lb	to 60	Petit Grain.....	per lb	to 28 00
Sesquinitrate.....	per lb	to 44	Olive, pure.....	per gal	to 2 50
Subsulphate.....	per lb	to 1 70	Marseilles, quarts.....	per box	to 8 00
Sulphate, pure.....	per lb	to 9	pints.....	per box	to 7 25
Exalcoat.....	per lb	to 17	Orange.....	per lb	to 4 25
Sulphuret.....	per lb	31 1/2 to 85	Origanum.....	per lb	75 to 1 50
Superphosphate Syrup.....	per lb	to 65	Patchouly.....	per oz	to 4 25
Tannate.....	per lb	to 6 60	Pennyroyal.....	per lb	8 75 to 4 00
India Ink.....	per lb	to 1 75	Peppermint, pure.....	per lb	6 00 to 4 25
Isinglass, American.....	per lb	to 1 55	Rhodum.....	per lb	to 10 00
Ruselan, true.....	per lb	to 6 60	Rose, Kleanlick.....	per oz	to 11 00
Juniper Berries.....	per lb	to 6	Rosemary, French.....	per lb	to 1 75
Juniper ".....	per lb	to 8 75	Trieste.....	per lb	to 1 15
Kreosote.....	per lb	to 1 90	Chris.....	per lb	to 2 25

Oil, Sabine, pure.....	per lb	to 2 00	Scammony, virg., true.....	per lb	to 20 00
Sassafras, cans.....	per lb	to 1 30	Seeds, Anise.....	per lb	to 25
Sassafras, Salad, fine.....	per lb	to 2 50	star.....	per lb	to 55
Spearmint, Hotchkiss.....	per lb	6 50	Canary, Dutch.....	per bush	to 5 00
Spike.....	per lb	to	Smyrna.....	per bush	to 5 00
Succinum, crude.....	per lb	to 60	Cardamom, Malabar.....	per lb	to 4 75
r. citified.....	per lb	to 70	Carul.....	per lb	to 22
Tanzy, "Eastman's".....	per lb	to 5 00	Celery.....	per lb	to 75
Thyme, white, pure.....	per lb	to 2 75	Clover.....	per lb	to 16
Valerian.....	per lb	to 18 00	Colchicum.....	per lb	to 24
Wintergreen.....	per lb	to 5 25	Coriander.....	per lb	to 16
Wintergreen, Van Deusen Bros.....	per lb	to 5 25	Cummin.....	per lb	to 20
Wormwood.....	per lb	to 7 00	Fennel.....	per lb	to 20
Wormseed, Western.....	per lb	to 2 75	Foennigreek.....	per lb	to 12
Baltimore.....	per lb	to 3 50	Hemp.....	per bush	to 2 55
Black Pepper.....	per lb	to 1 25	Linseed, American clean.....	per tierce	to
Cognac.....	per oz	to 3 50	rough.....	per bush	to 2 50
Ergot.....	per oz	to 25	Bombay (gold).....	per bush	to 2 50
Opium.....	per lb	to 19 00	Calcutta (gold).....	per bush	to 2 55
Orange Buds or Apples.....	per lb	to 18	Mustard, brown.....	per lb	to 16
Curacao Ribs.....	per lb	to 28	white.....	per lb	to 16
Otto Rose, pure.....	per oz	11 00	Rape.....	per bush	to 5 25
commercial.....	per oz	to 7 50	Timothy.....	per bush	to 5 00
Peppers, Zanzibar.....	per lb	to 38	Worm.....	per lb	to 28
Phosphorus.....	per lb	to 1 20	Seidlitz Mixture.....	per lb	to 45
Amorphous.....	per lb	to 3 25	Senna, Tinnevely.....	per lb	28 to 30
Piperin.....	per oz	to 1 50	Alexandria.....	per lb	45 to
Podophyllin.....	per oz	to 80	E. I.....	per lb	to 25
Poppy Heads.....	per lb	to 25	Smalts, Blue.....	per lb	to 22
Potassa, Acetate.....	per lb	to 80	Snuff, Lorillard's Maccaboy.....	per lb	to 78
Bicarbonate.....	per lb	to 42	Coarse Rappes.....	per lb	to 1 00
Carbonate.....	per lb	to 25	Irish High Toast.....	per lb	to 85
Caustic, common.....	per lb	to 65	Fresh Scotch.....	per lb	to 85
white.....	per lb	to 95	Soap, Castile, Mottled.....	per lb	16 to 17
Citrate.....	per lb	to 1 15	White.....	per lb	25 to 27
cum Calce.....	per lb	to 75	floating.....	per lb	to 25
Hypophosphite.....	per lb	to 4 25	Low's Brown Windsor.....	per gra	to 15 50
Permanganate, ordinary.....	per lb	to 80	Soda Acetate.....	per lb	to 80
Phosphate.....	per lb	to 2 75	Chlorate.....	per lb	to 2 15
Prussate.....	per lb	to 44	Chloride, Liquor.....	per gal	to 45
Sulphate.....	per lb	to 16	Citrate.....	per lb	to 1 00
Tartrate.....	per lb	to 1 05	Hydrosulphate.....	per lb	to 1 05
Potassium.....	per oz	to 3 75	Hypophosphite.....	per lb	to 4 10
Bromide.....	per lb	to 1 80	Hyposulphite.....	per lb	to 10
Cyanide, fus.....	per lb	to 82	Nitrate, pure.....	per lb	to 22
gran.....	per lb	to 1 50	Phosphate.....	per lb	to 31
Iodide.....	per lb	to 5 25	Pyrophosphate.....	per lb	to 1 25
Sulphuret.....	per lb	to 35	Sulphite.....	per lb	to 32 1/2
Quinine, Citrate, with Iron.....	per oz	to 85	Ash.....	per lb	to 4
Sulphate, American.....	per oz	to 2 65	Sodium.....	per lb	to 11 00
French.....	per oz	to 2 55	Iodide.....	per lb	to 8 00
Quassia, rasped.....	per lb	to 7	Spirit Ammonia.....	per lb	to 48
Red Chalk Fingers.....	per lb	6 1/2 to 7	Aromatic.....	per lb	to 50
Red Precipitate.....	per lb	to 1 15	Lavender.....	per lb	to 50
Resin of J lap, pure.....	per lb	to 28 00	Nitro Dulc.....	per lb	to 40
Rochelle Salt.....	per lb	48 to	Rosemary.....	per lb	to 50
Roots, Aconite.....	per lb	to 24	Sponges, Bahama.....	per lb	to 90
Alkanet.....	per lb	17 to 18	Bathing, Formes.....	per lb	to 4 00
Althea.....	per lb	22 to 28	Coarse Brown.....	per lb	to 60
Angelica.....	per lb	to 35	Fine, medium.....	per lb	6 00 to 7 00
Calamus.....	per lb	20 to 60	Surgeon's.....	per lb	4 00 to 7 00
Colchicum.....	per lb	to 20	Zilmoca.....	per lb	2 00 to 3 00
Colombo.....	per lb	to 24	Cup, Turkey.....	per lb	20 00 to 30 00
Culveris.....	per lb	to 20	Trieste.....	per lb	4 50 to 13 00
Dandelion.....	per lb	to 30	Fine Toilet, bleached.....	per lb	12 00 to 15 00
Galangal.....	per lb	to 12	Fine Trieste, small.....	per lb	4 00 to 4 50
Gentian.....	per lb	to 14	Glove.....	per lb	1 75 to 2 00
Ginger, Race, African.....	per lb	to 20	Grass.....	per lb	to 25
Jamaica, Bleached.....	per lb	to 32	Sheep's wool.....	per lb	1 60 to 1 70
Golden Seal.....	per lb	to 30	Sur Choix.....	per lb	to 5 50
Hellebore black.....	per lb	to 16	Squills.....	per lb	to 12
white, powdered.....	per lb	to 65	St. John's Bread.....	per lb	to 8
Ipecacuanha.....	per lb	to 3 30	Strontia, Muriate.....	per lb	to 30
powdered.....	per lb	to 3 40	Nitrate.....	per lb	to 30
Jalap.....	per lb	to 2 00	Oxalate.....	per lb	to 1 80
powdered.....	per lb	to 2 30	Strychnia, Acetate.....	per oz	to 3 75
Licorice.....	per lb	to 18	Citrate.....	per oz	to 75
Mandrake.....	per lb	to 15	Nitrate.....	per oz	to 3 75
Orris, Florentine.....	per lb	to 16	Pure, crystallized.....	per oz	to 3 50
Verona.....	per lb	to 14	powdered.....	per oz	to 3 25
Pink.....	per lb	to 33	Sulphate.....	per oz	to 3 75
Rhatany.....	per lb	to 30	Valerianate.....	per oz	to 5 50
Rhubarb, E. I.....	per lb	2 50 to 4 00	Styrax Calamita.....	per lb	to 55
Turkey.....	per lb	to 24 00	Sugar of Lead.....	per lb	to 42
Sarsaparilla, Honduras.....	per lb	to 55	Sugar of Milk.....	per lb	to 58
Mexican.....	per lb	to 30	Sulphur Sublime.....	per lb	6 1/2 to 7
Turbeth.....	per lb	to 60	Tamarinds.....	per lb	to 10
Valerian, English.....	per lb	to 65	Tannin.....	per lb	to 2 75
Dutch.....	per lb	to 40	Tapioca, East India, white.....	per lb	to 16
German.....	per lb	to 26	Pearl.....	per lb	to 18
Vermont.....	per lb	to 40	Tartar Emetic, powdered.....	per lb	to 95
Snake, Virginia.....	per lb	to 44	crystallized.....	per lb	to 1 15
Seneca.....	per lb	to 70	Tin Foil, thin.....	per lb	to 45
Rose Leaves.....	per lb	to 2 50	French, No. 15.....	per lb	to 70
Rosemary Leaves.....	per lb	to 12	Tobacco.....	per lb	to 40
Rubigo Ferri.....	per lb	to 10	Tonqua Beans, Pars.....	per lb	to 75
Saffron, American, new.....	per lb	to 2 25	Augustora.....	per lb	to 95
Spanish, true.....	per lb	to 17 00	Uva Ursi, American.....	per lb	to 12
Sago, Pearl.....	per lb	to 12	French.....	per lb	to 13
Salicin.....	per oz	to 60	Vanilla Beans, Bourbon.....	per lb	to 11 00
Sal Acetosella.....	per lb	to 55	Mexican.....	per lb	to 15 00
Ammoniac.....	per lb	to 16	Venice Turpentine.....	per lb	to 33
Soda, Newcastle.....	per oz	to 6	Veratria.....	per oz	to 5 25
Santonine.....	per oz	to 1 80	Vitriol, Blue.....	per lb	14 to 15
Sassafras Bark.....	per lb	to 15	Green.....	per lb	to 2

Vitriol, White.....	per lb	to 9
Wax, White,—J. I. Elkins.....	per lb	to 75
No. 2.....	per lb	to 72
Phillips'.....	per lb	to 90
Yellow.....	per lb	to 52
White Wax,—Leonhardt's.....	per lb	to 90
Oekmid.....	per lb	to 82
Sun-bleached.....	per lb	to 80
White Precipitate.....	per lb	to 1 50
White Pepper.....	per lb	to 58
Wine, Colebecum Seeds.....	per lb	to 1 40
Wood Naphtha.....	per lb	to 95
Wormwood Herb.....	per lb	to 25
Yellow Bark.....	per lb	to 80
Dock.....	per lb	to 25
Zaffre.....	per lb	to 1 15
Zinc, Acetate.....	per lb	to 1 25
Chloride.....	per lb	to 1 80

DYES AND DYE STUFFS.

Aniline Blue.....	per lb	to 8 00
Red.....	per lb	to 7 50
Violet.....	per lb	to 8 00
Annatto.....	per lb	to 1 75
Cochineal, Honduras.....	per lb	to 1 40
Mexican.....	per lb	to 1 30
Cudbear.....	per lb	to 28
Cutch, Pegue.....	per lb	to 18
Gambler.....	per lb	to 8
Indigo, Bengal, fine.....	per lb	to 3 25
good.....	per lb	to 2 50
middling.....	per lb	to 2 00
Madras, fine.....	per lb	to 1 60
ordinary.....	per lb	to 1 00
Kurpah.....	per lb	to 2 00
Guatemala.....	per lb	to 2 10
Caracas.....	per lb	to 1 65
Lac Dye, good to fine.....	per lb	to 55
Logwood, Campeachy.....	per lb	to 2 1/2
Honduras.....	per lb	to 2 1/2
Jamaica.....	per lb	to 2 1/2
Lacuna.....	per lb	to 2 1/2
St. Domingo.....	per lb	to 2
Extract.....	per lb	to 13
" in bulk.....	per lb	to 13
Lima Wood (gold).....	per bbl	to 70 00
Madder, Dutch.....	per lb	to 22
French.....	per lb	to 23
Nutgalls, Blue, Aleppo.....	per lb	to 40
Orehle.....	per lb	to 30
Persian Berries.....	per lb	to 50
Safflower.....	per lb	to 60
Sapanwood.....	per lb	to 12
Turneric.....	per lb	to 15
Ultramarine.....	per lb	to 23
Wood.....	per lb	to 15

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials.....	percentage discount.
German Flint Bottles and vials.....	80
Flint Bottles and vials.....	25
Furniture Ware.....	10
Perfumer's Ware.....	25
Chemical Ware.....	net
Syringes.....	10
Homoeopathic vials.....	10

NAVAL STORES.

Pitch, City.....	per bbl	to 4 00
Rosin, Extra Pale.....	per 280 lbs	to 8 00
Pale.....	"	to 7 00
No. 1.....	"	to 5 00
No. 2.....	"	to 4 00
Strained.....	"	to 4 00
Common.....	"	to 3 75
Spirits, Turpentine (North Carolina).....	per gal	to 55
Turpentine, Soft.....	per 280 lbs	to 8 00

OILS.

Linseed Oil, American.....	per gal	to 1 15
English.....	per gal	to 1 15
Palm Oil.....	per lb	to 16
Paraffine Lubricating Oil.....	per gal	to 40
Sperm, Crude.....	per gal	to 2 20
Sperm, Winter, unbleached.....	per gal	to 2 20
Lard Oil Prime, City.....	per gal	to 1 60
Red Oil, City distilled.....	per gal	to 70
Red Oil, Saponified.....	per gal	to 78
Whale, Crude.....	per gal	to 1 85
Whale, Bleached, Winter.....	per gal	to 1 40

PAINTS (DRY).

Asphaltum, opt.....	per lb	to 7
Barytes, Foreign.....	per ton	to 45 00
Barytes, American.....	per lb	to 2
Black Lead.....	per lb	to 8
Black Ivory, drop, fair.....	per lb	to 10
good.....	per lb	to 18
best.....	per lb	to 24
Blue Celestial good.....	per lb	to 14
Chinese.....	per lb	to 1 00
Prussian, fair to best.....	per lb	to 35
Ultramarine, fair to best.....	per lb	to 23

Chalk, Lump.....	per lb	to 2 1/2
China Clay.....	per lb	to 2 1/2
Chalk.....	per bbl	to 4 50
Green Paris, fair to best.....	per lb	to 35
Green Chrome, fair to best.....	per lb	to 38
Lamp Black—Coach Painter's—L. Martin & Co.'s.....	per lb	to 23
Lamp Black, ordinary.....	per paper	to 8
Litharge, powdered, American & English.....	per lb	to 11
Ochre, Yellow, French, dry.....	per lb	to 2 1/2
R-d Venetian.....	per lb	to 3 1/2
Red Indian, fair to best.....	per lb	to 11
Red Lead, American.....	per lb	to 11
English.....	per lb	to 14
Rose Pink.....	per lb	to 20
Sienna, American.....	per lb	to 7
Italian, B't.....	per lb	to 18
Raw.....	per lb	to 15
Umber, Crude, Turkey.....	per lb	to 5
burnt.....	per lb	to 8
Tieman's Calif. Vermillion.....	per lb	to 1 10
Pure Carmine.....	per lb	to 16 00
Soluble Blue.....	per lb	to 1 25
Vermillion, English, pale.....	per lb	to 1 25
deep.....	per lb	to 1 20
American.....	per lb	to 35
Chinese.....	per lb	to 1 30
Trieste.....	per lb	to 1 20
White, China.....	per lb	to 22
Cremnitz.....	per lb	to 30
Lead, pure.....	per lb	to 13
good.....	per lb	to 9
Paris.....	per lb	to 3 1/2
Zinc, American.....	per lb	to 10
Zinc, French.....	per lb	to 14
Whiting.....	per lb	to 8 1/2

PAINTS (IN OIL).

Black coach.....	per lb	to 28
Blue, Chinese.....	per lb	to 90
Prussian, fair to best.....	per lb	to 85
Brown, Van Dyke, fair to best.....	per lb	to 20
Dryer, Patent, American.....	per lb	to 12 1/2
English.....	per lb	to 12 1/2
Green, Chrome.....	per lb	to 18
Imperial.....	per lb	to 15
Paris.....	per lb	to 38
Verdigris.....	per lb	to 25
Putty, in bladders.....	per lb	to 5 1/2
in bulk.....	per lb	to 5 1/2
Red Venetian, fair to best.....	per lb	to 8
Sienna, burnt, fair to best.....	per lb	to 22
White Lead, English, B. B.....	per lb	to 16
American, pure.....	per lb	to 13 1/2
good.....	per lb	to 11
fair.....	per lb	to 9
White Zinc, American.....	per lb	to 10
French.....	per lb	to 15
Yellow Ochre.....	per lb	to 9
Chrome, fair to best.....	per lb	to 16

SPICES.

Cassia, in mats.....	per lb	to 75
Cloves.....	per lb	to 42
Ginger, Race, African.....	per lb	to 19
Mace.....	per lb	to 1 55
Nutmegs, No. 1.....	per lb	to 1 45
Pepper.....	per lb	to 35
Pimento, Jamaica.....	per lb	to 84

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6 by 8 to 8 by 10.....	Per fifty feet	to 3 75
8 by 11 to 10 by 15.....	"	to 6 75
11 by 14 to 12 by 18.....	"	to 7 50
13 by 16 to 16 by 24.....	"	to 8 50
18 by 22 to 18 by 30.....	"	to 10 00
20 by 30 to 24 by 30.....	"	to 12 50
24 by 31 to 24 by 36.....	"	to 14 00
25 by 36 to 26 by 40.....	"	to 16 00
28 by 40 to 30 by 48.....	"	to 18 00
24 by 54 to 32 by 56.....	"	to 20 50
32 by 58 to 34 by 60.....	"	to 24 00
34 by 62 to 40 by 60.....	"	to 26 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6 by 8 to 8 by 10.....	Per fifty feet	to 4 75
13 by 11 to 10 by 15.....	"	to 6 75
11 by 14 to 12 by 18.....	"	to 7 50
13 by 15 to 16 by 24.....	"	to 8 50
28 by 22 to 18 by 30.....	"	to 20 00
30 by 30 to 24 by 30.....	"	to 12 00
24 by 31 to 24 by 36.....	"	to 14 00
25 by 36 to 30 by 45.....	"	to 16 00
32 by 40 to 30 by 48 (3 qlts).....	"	to 18 00
34 by 54 to 32 by 56 (4 qlts).....	"	to 20 50
32 by 56 to 36 by 60 (3 qlts).....	"	to 24 00
4 by 52 to 40 by 60 (3 qlts).....	"	to 26 00

Subject to a discount of 30 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.

Vol. IV. No. 5. American Reprint.

SETTING TO WORK.

BAD as man is, he is too good to be quite pleased with the present—too good not to feel sympathy with the struggles of the past, and too good not to hope for a better future. The present we see, so far as our eyes permit us; the past we almost see beside us, in nations that have little changed; and the future seems to be forming almost before our eyes. In a very wonderful picture of the English race moving over the world with cities of civilisation as numerous as the tents of those former men who carried desolation before them, we learn in Mr. Dilke's "Greater Britain," that, even west of the Mississippi, 22,000,000 of acres of land have been devoted to the purposes of education, and millions on millions are to follow. The whole of England and Wales contain only 38,000,000 acres of land not so rich, but all that American expanse is at once made sacred. As a result of a similar policy in Michigan, a university has arisen, which teaches for a sum which may be considered merely as an acknowledgment of its position—10 dollars for entrance, and 5 dollars annually afterwards. Michigan is of the same size as England and Wales; it has 38,000,000 acres. This our country has turned into many by a kind of gemmation, and principles grown amongst us, but not carried out, are flourishing among people whom circumstances, perhaps, have enabled more honestly than us to do as we feel we ought to do. We see our future growing not far away, but it seems to us as a kind of martyrdom to enter it. It is already a law that no man shall die for lack of bread; it is not yet a law that no one shall sink into worse than death for lack of teaching. But we must arrive at this point—our nature decides for it. We compel every child over whom we have influence in private life to learn, and, as our hearts enlarge, our influence will widen its circle.

This expansion has shown itself lately. The exertions of private men have been incredibly great, and the work which some have done places them so high that we can no longer doubt that even our generation can produce heroes that no age would despise. But the work has been insufficient; a private man among thousands does good, but it is too little, and the man dies of exhaustion, or at least by time. An agent from the Government comes, the people crowd around him, he is received with delight, and the work is done to the extent required—and sometimes further—in any department to which the Government turns its attention. There are two departments of education, which show what local interests can do and what Governments can. The church, of which we are not authorised to speak, has been preserved by the state, without loss of income and in full power. The schools for the young, left by individuals, or in the hands of small irresponsible boards, have gone, in numerous instances, to ruin. We cannot argue fully the whole subject, but we think these facts give fair arguments. In Scotland, the parish school system, also, has been preserved, because defended by Government. It may be said that the parish schools have not grown with the age: it is true; but they have not had their small stipends used for feeding the wealthy, and growth has not been entirely absent. Had provision been made for growth, the system had been perfect.

And now what is Government to do? And are we to begin to be the ten-thousandth instructor of Government, and lay down a plan which we suppose all men will follow? No, we do not intend to lay down systems for the nation; we think that peculiarly the work of legislators—of men who know the mode of carrying out principles among their fellow men. We prefer to speak less ambitiously; we think it proved, by the experience of some three hundred years, that the state can take care of revenues for education. Can it also take care of education? On this point, most people will say that it has done so too rigidly, and that an expansion from time to time was desirable. A judge was told by a barrister that a certain act demanded that a large disputed sum should be unreservedly in the hands of a very young claimant. What said the judge? "Am I going to allow a young man to be ruined, simply because of some words in an Act of Parliament?" Here was discretion. All men are not capable of a wise discretion; and the constant opposition to everything proposed has prevented movements which the spirit, but not the letter of laws, dictated.

To keep up the standard of education is really the business of the universities, and to them we must look for examiners. There is no man more important than an examiner; he rules the youth of to-day; he has more influence on them than all the previous and existing thinkers of the world besides. To please him, the young men read, and they learn his ideas; he has his opinion—he even has his crotchets, and they are received with respect. This is an evil that arises from one set of examiners, and a reason why a nation must have several. The same reason applies to universities. France prefers to carry out one idea—to model her schools on one pattern; there is something grand in it. One only can be perfect, and why, then, have two patterns? It is the perfect way of the heavenly future, but can be right only for a nation that cannot go wrong. To make many millions think on one model, is, one would suppose, the surest way to suppress originality. It will have its effect; there must be many tastes among many minds. We believe that one great university will mould a nation more thoroughly than many will; but we prefer the waywardness and eccentricity that are the diseases of men of original character to that uniformity and smoothness which we think will be produced by the military school system.

In the fulness and freedom of our universities, we shall have, perhaps, the best guarantee of the education being the most advanced. When untrammelled in teaching, and their revenues guided, they may not become so disinclined to move as in past times. When public opinion itself sinks, who is to raise it? When new branches of knowledge arise, who is to provide for the new teachers? If all the funds are given to those of to-day, there must be less to each if the numbers are increased to-morrow. In such a case, there is the plan well known—first come first served; and there is the other plan, not unknown either—to give Benjamin the largest share. There are, also, intermediate plans, if no other funds can be got; but is anything sadder than to leave untaught a great department of knowledge, simply because the funds are already granted to men who have never served any but themselves?

It is hoped that no such questions will again arise, but that a free intercourse between the state and the universities will cause abundant provision to be made for all laudable pursuits. As a rule, men will fight for themselves; and it is a fault of a nation if it is not.

laws which incite men to resist the public good in order to advance even their moderate wishes. Men commit crimes sometimes from want of knowing that better results could be got for themselves without crimes.

Surely if a state preserves or gives the property, the universities may give the learning. If any of these should become wild, and teach doctrines opposed to the nation's better feelings, the state must interfere, but not otherwise; toleration ceases with all men at some point. No one discusses the propriety of murder—the question is settled; but we discuss capital punishments, because there are wise men of opposite opinions. To what body is it possible to give this lofty supervision, except to the state, which, moreover, by the will of nations, takes it of a necessity?

But if the property is thus preserved, and the learning secured, what shall be done with both? At present, the principal inclination is to encourage study by prizes and scholarships. We believe, that by a simple minute at the end of 1867, the Government has decided the fates of the children for many years to come; they will learn more science—they will change the character of the nation; there will be a greater audience for words lectured or read, and the national mind will speak more strongly on scientific objects.

We have begun by encouraging scholars with money; in England moneyed men send their sons where money prizes can be got. We teach the child to read by a sweetmeat; but this may last too long. If it endures three centuries, like some of our educational habits, so much the worse for this country. In America, it is already ceasing, competition for prizes being considered hurtful; and in a great university, which does not even take money for teaching, it is unseemly for students to fight for mere gain.

We should prefer to see more rewards given to those who had spent their strength and their lives, serving their age by their studies; we think that this class of reward ought to increase, whilst student rewards diminish. Many a precious life has been destroyed by long fellowships without duties, and many have been rendered unhappy by having the aid removed at a time of life when it was most required. It seems proper, and according to natural law, that the finished student should, as a reward, have work given him; that is the true fellowship. We could point out students under twenty making so much money by prizes that it would be considered as a very handsome pension by old scientific men. Yes, we could point out one who has written papers by scores, and spent thousands of pounds on science, who would be glad of it. True, these student incomes do not last above two or three years; but fellowships last longer, or, on certain conditions, for life. At this moment there are men who have devoted themselves to various branches of science, ready at all times to give their knowledge to all who ask for it; we must confess that we should prefer fellowships going to such men rather than to those who were only eminent students. The reward of the student arises from an old idea that he who had studied a master had completed his knowledge; the modern idea has a boundless nature before it, and he who has finished his university studies is only beginning his career. The student has life and hope before him; study is a privilege now, in an intellectual age when we need rather to diminish the desire, lest the brain should suffer, and when men row or run as a discipline, instead of as in ancient times making a business of sports. We know the opposing arguments, but we still say—give work to the young and rest to the

old. For ourselves, we believe that a house must be very poor that has not a warm corner for the oldest, who has done his work or the greater part of it; and the hearts in it must be poorer still if they do not delight in giving to such the finest delicacies at meals. Many severe and true things have been said against sinecures, but no civilised man ever included such as these. Families must have them; no nation with a clear intellect can be without them, because, even without a heart, it may see its advantage in rewarding well done work. We believe that in this direction rewards for scientific men would be wisely increased rather than for mere students. The chimney corner of the nation must be kept warm.

We know well another side. What is finer than to see the adventurous youth struggling for a prize whereby to live, that he may study, and, by pure force of genius, lifting himself out of poverty and hopelessness to honour and applause? We hope prizes for this purpose will continue in our universities until poverty shall cease; but when one has learnt, make him work.

Of course there are many other modes of viewing the subject; we may take one becoming very popular of late, we may call it the Fijian. The aristocratic party of a Fiji island held that a man at forty, having lost his agility, might, for economy's sake, be eaten. It is easier in those places to tell when a man is of value than it is with us; they can measure the amount of food he brings home, but the value of our men may be in a single thought, and we treasure the individual, listening as to an oracle, not knowing what effects on the world the next word may cause. Even in an economical point of view, we object to the Fijian method. A little sickness or headache is often followed by a long time of great activity; but we have heard of a young Fijian, who had somewhat lost her appetite, and, looking out of her hut, saw at the door her grave, into which she was thrust, and covered up by the work of five minutes. We adopt Fijian policy in many cases here, when a man is paid by the number of strokes he gives a hammer, and when tired is sent off to seek in the workhouse the only compassion that a nation can give by deputy. It seems needful in many cases, because we must struggle against deception; but as men rise in the scale of humanity, the hard reasoning ceases to guide them, because reason is unable to estimate the value of a good man.

These points are all interesting, but we must not go too far aside from the main interests of scientific men. The greatest favour which a nation can do them is to give them employment, each according to his kind. Perhaps some may suppose that we are now going to devise situations for them, and propose to clamour that all these shall be filled up instantly, so that no longer shall men of science be without honour and comfort. Well, if we could, we would situate them all well; and, after all, there are not so many in the nation as to make the burden too heavy. But it is not to be done: they must fight like other men—"man must go out among his foes working and struggling." Still we ask—How shall a nation best make use of that peculiar power obtained by the study of science; how shall it organise those invisible forces, as it has organised the army and navy, and the equally invisible courage of the human heart, that prompts ever to resist aggression? These great questions must be settled for national, and not merely private benefit, and then more time will be given for warming the chimney corner, which, after all, is not the least of things.

It has taken many centuries to reduce an army to order—its equipments have been changed in our own day; and the navy is now in process of change. Since Marcus Græcæ burnt saltpetre, sulphur, and charcoal, and made something like a rocket project, the changes have been many, the principle one.

We have gone to Alexandria for our systematic scientific beginning, and the museums of Europe are parts of the system begun of old. Perhaps our British Museum is the truest model we know. These museums are increasing over the country. They are becoming associated with parks; and a beautiful beginning of this kind we have in that admirable spot at Kew. It does seem to us that to add learned persons in real life to these institutions is a true policy. These places offer fine opportunities for lectures, and it is a question whether it is not well to imitate Paris in her *Jardin des Plantes*, and have these lectures free. A thousand objections arise; we know most, but we know something also of the people of England, and we are persuaded that the logic of facts is always sure to find among them ready listeners, whilst they are ever ready to make flights by that most delightful of methods, a train of thoughts. These lectures ought not to be profound. We hear lecturers complain of want of attention. If you speak Greek, how do you expect English people to understand you, even if they have been at a university? The profoundest thinker may find it hard to teach the meanest child. People imagine that it is because he knows too much, but this is a mistake, it is because he knows too little. He has passed in a kind of balloon, or in an inflated sort of way a whole region of thought, the very region which the child wishes to travel, but the poor thing can get no guide; and by degrees it is of necessity driven to take the same balloon passage, or some night conveyance. Let the truth told be worth thinking of, and earnest men will come; let them be interesting to the imaginative, and light thinkers will come; let them be cheerful as nature is cheerful, and the gayest will come. Already children are rising up that require science among their thoughts; and the active intellects that are growing more numerous will do evil if not good. We think this a fine field for scientific work. We have few towns with scientific men in them. There is a dreary lack of them in many places, and it is absolutely needful to fill up this lack as salt is to preserve meat. We have torn down the superstitions of our ancestors that filled their active minds; we have taken from our Northmen and Celts their numerous and interfering spirits, and removed from them the society of the spirits of the dead and the wandering doubles of the body; we have taken away the interesting fairies, trolls, and brownies, and we have stopped the mild and merry adventure that brought glory on the sea, and frightened the sea-board from Thule to Constantinople. It is true we have taught the duties of a calmer life, and we desire no longer to return to the past and its faith, but we feel the need of substitutes for the imagination and for the bodily, active, and porpoise-like delight which made our dreaded ocean a place of rest to rovers. The nation makes to itself a substitute by roaming over the world, but the many at home want interest also, and there is more than enough for any man, in science, art, and general progress. We have seen men pining in country places, in villages, and even in large towns, and we are convinced that, by good teaching, double power could readily be produced in this nation. The old arms are useless; we must take the new ones and distribute them.

The teaching of science in schools, and keeping it alive in museums, seem two important methods now begun. Let benevolent men further them. These are not the only modes: some time ago a movement was made to induce corporations to appoint scientific men—chemists—to analyse food, and to see that it was sold in purity. This was a fine opportunity of diffusing science and its benefits. Will town councils refuse it because perhaps, the analyst will not have enough to do? It is an opportunity for having a scientific man to consult; and he might be rendered useful in many ways to men who are far too much inclined to go on their own judgment, which, of course, can only be the average of intelligent—not specially trained men. Food alone will not occupy the time probably. It is a much to be lamented thing that scientific advisers are so constantly rejected or ignored in the government of cities. We think the chemist particularly required: his life has been looked on as a parasite of medicine, but he is really a separate man. We are unable to tell the many things for which a chemist might be useful in a city, but if he only prevented houses and whole cities being built with bad bricks and mortar, he would be worth his weight in solid gold, and much more.

The work is not for any one class of men. Meteorology and astronomy, so often going together, are beginning to come more actively into daily life than usual. The use of the latter is old; and the state has made by its aid guides for the sea, and even for the land. Its younger sister is now rising into fame, and the museum will never be complete without an establishment that is always so interesting to Englishmen, and which promises to give us some knowledge of the regions of the air, and to guide us in commerce and in agriculture, which at present so peculiarly demand our attention. And here we come round to chemistry again, brought by our numerous shipwrecks. Does it not seem strange, that a nation that depends so much upon iron should not be able to tell the composition of a good ore, or of a sound piece of metal? Few iron companies, that we know of, keep a chemist constantly occupied with the subject, and men in London, for the love of pure science, must find whether there ought to be phosphorus in good steel or not. It would be wise for the iron-masters to keep a dozen chemists on high salaries, analysing for years, until the results amounted to thousands. Generally, they desire the results in a few days, and made as cheaply as possible. The results may be of no value for years, but valuable they will be; and if iron-masters care little for the future, we can only hope that this question is one which will be taken up by the nation, and that, for the sake of commerce, manufacturers, and that part of humanity which suffers from wrecked iron vessels, boiler explosions, and breakages of machinery, such inquiries shall be made as shall settle these questions for ever, although a century may be needed for the investigation.

ON ENGLISH AND FOREIGN ALKALIMETRICAL AND CHLORIMETRICAL DEGREES.*

BY JOHN PATTINSON, F.C.S.

THE relations between English and foreign alkalimetric and chlorimetric degrees are but little known amongst merchants, chemical brokers, and others, who are in the habit of exporting large quantities of alkali, soda-ash, and bleaching powder; and it is a remarkable fact, that,

* Read before the Newcastle Chemical Society, January 28th, 1869.

COMPARATIVE TABLES
OF
ENGLISH AND FOREIGN ALKALIMETRICAL AND CHLORIMETRICAL DEGREES.

ALKALIMETRICAL TABLE.

Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizille's Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizille's Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizille's Degrees.
30.0	51.29	30.39	47.42	46.0	78.66	46.60	72.71	62.0	106.01	62.82	98.00
30.5	52.14	30.90	48.21	46.5	79.51	47.11	73.50	62.5	106.86	63.32	98.79
31.0	53.00	31.41	49.00	47.0	80.37	47.62	74.29	63.0	107.72	63.83	99.58
31.5	53.85	31.91	49.79	47.5	81.22	48.12	75.08	63.5	108.57	64.33	100.37
32.0	54.71	32.42	50.58	48.0	82.07	48.63	75.87	64.0	109.43	64.84	101.16
32.5	55.56	32.92	51.37	48.5	82.93	49.14	76.66	64.5	110.28	65.35	101.95
33.0	56.42	33.43	52.16	49.0	83.78	49.64	77.45	65.0	111.14	65.85	102.74
33.5	57.27	33.94	52.95	49.5	84.64	50.15	78.24	65.5	111.99	66.36	103.53
34.0	58.13	34.44	53.74	50.0	85.48	50.66	79.03	66.0	112.85	66.87	104.32
34.5	58.98	34.95	54.53	50.5	86.34	51.16	79.82	66.5	113.70	67.37	105.11
35.0	59.84	35.46	55.32	51.0	87.19	51.67	80.61	67.0	114.56	67.88	105.90
35.5	60.69	35.96	56.11	51.5	88.05	52.18	81.40	67.5	115.41	68.39	106.69
36.0	61.55	36.47	56.90	52.0	88.90	52.68	82.19	68.0	116.27	68.89	107.48
36.5	62.40	36.98	57.69	52.5	89.76	53.19	82.98	68.5	117.12	69.40	108.27
37.0	63.26	37.48	58.48	53.0	90.61	53.70	83.77	69.0	117.98	69.91	109.06
37.5	64.11	37.99	59.27	53.5	91.47	54.20	84.56	69.5	118.83	70.41	109.85
38.0	64.97	38.50	60.06	54.0	92.32	54.71	85.35	70.0	119.69	70.92	110.64
38.5	65.82	39.00	60.85	54.5	93.18	55.22	86.14	70.5	120.53	71.43	111.43
39.0	66.68	39.51	61.64	55.0	94.03	55.72	86.93	71.0	121.39	71.93	112.23
39.5	67.53	40.02	62.43	55.5	94.89	56.23	87.72	71.5	122.24	72.44	113.02
40.0	68.39	40.52	63.22	56.0	95.74	56.74	88.52	72.0	123.10	72.95	113.81
40.5	69.24	41.03	64.01	56.5	96.60	57.24	89.31	72.5	123.95	73.45	114.60
41.0	70.10	41.54	64.81	57.0	97.45	57.75	90.10	73.0	124.81	73.96	115.39
41.5	70.95	42.04	65.60	57.5	98.31	58.26	90.89	73.5	125.66	74.47	116.18
42.0	71.81	42.55	66.39	58.0	99.16	58.76	91.68	74.0	126.52	74.97	116.97
42.5	72.66	43.06	67.18	58.5	100.02	59.27	92.47	74.5	127.37	75.48	117.76
43.0	73.52	43.57	67.97	59.0	100.87	59.77	93.26	75.0	128.23	75.99	118.55
43.5	74.37	44.07	68.76	59.5	101.73	60.28	94.05	75.5	129.08	76.49	119.34
44.0	75.23	44.58	69.55	60.0	102.58	60.79	94.84	76.0	129.94	77.00	120.13
44.5	76.08	45.08	70.34	60.5	103.44	61.30	95.63	76.5	130.79	77.51	120.92
45.0	76.95	45.59	71.13	61.0	104.30	61.80	96.42	77.0	131.65	78.01	121.71
45.5	77.80	46.10	71.92	61.5	105.15	62.31	97.21	77.5	132.50	78.52	122.50

The first column contains percentages of soda, calculated on the correct atomic weight—31. These also represent what are known in France as Gay-Lussac's degrees.

The second column contains the amounts of carbonate of soda corresponding to the soda in the first column. Soda ash is sold in Germany, Russia, &c., by the percentage of carbonate of soda it contains.

The third column gives the corresponding percentages of soda according to the English test, which is based on the old atomic weight of soda—32—still retained as a trade custom in England.

The fourth column shows the corresponding degrees of Decroizille's alkalimeter. These degrees represent the number of parts of monohydrated sulphuric acid (oil of vitriol) which can be neutralised by 100 parts of the sample under examination. Decroizille's degrees are used in France and some other parts of the Continent.

NOTE.—In the commercial testing of samples of soda ash and alkali, all the soda neutralised by test acid is taken into account, and reckoned as soda in the mode of stating the results shown in the first and third columns, as carbonate of soda as shown in the second column, and as degrees as shown in the fourth column.

CHLORIMETRICAL TABLE.

French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.
63	20.02	74	23.51	85	27.01	96	30.51	107	34.00
64	20.34	75	23.83	86	27.33	97	30.82	108	34.32
65	20.65	76	24.15	87	27.65	98	31.14	109	34.64
66	20.97	77	24.47	88	27.96	99	31.46	110	34.95
67	21.29	78	24.79	89	28.28	100	31.78	111	35.27
68	21.61	79	25.10	90	28.60	101	32.09	112	35.59
69	21.93	80	25.42	91	28.92	102	32.41	113	35.91
70	22.24	81	25.74	92	29.23	103	32.73	114	36.22
71	22.56	82	26.06	93	29.55	104	33.05	115	36.54
72	22.88	83	26.37	94	29.87	105	33.36	116	36.86
73	23.20	84	26.69	95	30.19	106	33.68	117	37.18

The French degrees represent the number of litres of chlorine gas, at 0° C. temperature (32° Fah.) and 760 m.m. barometric pressure (29.92 inches), which can be obtained from 1 kilogramme of the sample of chloride of lime (bleaching powder) under examination.

The English degrees represent the actual percentage of available chlorine contained in the sample under examination. This mode of stating the results is used in Germany, Russia, America, &c.

even in many of the laboratories of our chemical works, these relationships are very imperfectly understood. It is a common mistake to suppose that the alkalimetric degrees of Decroizille represent percentages of carbonate of soda; then, again, both English and foreign chemists who are unacquainted with the usages of the soda trade, erroneously take for granted that the English soda test is based upon the most recently established atomic weight of soda—31.

Doubtless, the want of knowledge on this subject is owing to the almost entire absence from our chemical handbooks of all information on the matter. I am not aware of any English book which gives the value of Decroizille's degrees; and in very few English books treating on alkalimetry is there any mention of the use of the atomic number, 32, as a basis for the test for soda in the English soda trade. I have also found a similar want of information on the relation between French and English chlorimetric degrees, very few of our handbooks mentioning the French method of stating the value of a sample of bleaching powder.

As may be easily conceived, the want of information on these matters, in trades of such magnitude as our soda and bleaching powder trades, is a fruitful source of misunderstanding and dispute. It appears to me that our young Society, established in the midst of one of the great seats of these trades, is a fitting medium through which to diffuse the requisite information. With a view to further this object, I have made the necessary calculations, and arranged two comparative tables—one showing the relations between the amounts of soda, carbonate of soda, English degrees, and Decroizille's degrees; and the other, the relation between French and English chlorimetric degrees. I am indebted to M. Kuhlmann, of Lille (himself a large soda manufacturer), for the correct statement of the value of Decroizille's degrees. (See preceding page).

It is, doubtless, highly desirable, for the sake of scientific accuracy and uniformity, that the atomic weight of 31 for soda, instead of 32, should be adopted in England as a basis for the test for soda. It is, however, always difficult to alter trade usages, and there are good reasons why this one should not be hastily changed. It gives to the manufacturer an advantage of 0.65 of a per cent. on a 50 per cent alkali—that is, an alkali testing 50 per cent by the English test, only contains 49.35 per cent of actual soda. In the London market, it is also an established custom in the alkali trade to pay for parcels of goods only on the whole degrees, and not on the fractions, so that an alkali which contains 50.9 per cent of soda, by the English test, is invoiced and paid for as only containing 50 per cent. It will thus be seen that the disadvantage to the manufacturer of the latter custom just about counterbalances the advantage gained by the former. It would, obviously, be unfair to alter one custom, and leave the other in force. Another trade custom, affecting the chemical manufacturer to his disadvantage, is that of assuming the amount of peroxide of manganese contained in a sample of manganese ore to be equal to the two atoms of carbonic acid evolved when the ore is tested by the ordinary oxalic acid process. These peculiar trade customs in analysis are a very frequent cause of misunderstanding and annoyance, and it would be well if they could be abolished in favour of methods which all chemists admit to be correct, according to the present state of chemical knowledge. I am of opinion, however, that these changes can only be effectually made by the chemical trade itself, and I recommend the subject to the consideration of the Alkali

Makers' Association. But so long as these trade customs continue in use it is desirable that exact information as to their nature should be attainable by all persons interested in the trade. The table here given will help to do this, so far as relates to the English soda test.

In making the calculations for the chlorimetric table, I have adopted the combining number of 35.46 for chlorine, as given by Stas and Marignac, and have taken 0.08961 gramme as the weight of a litre of hydrogen at zero centigrade and 760 m.m. pressure. The weight of 1 litre of chlorine, at the same temperature and pressure, is, therefore, 3.17763 grammes.

ON THE

IMMEDIATE ANALYSIS OF DIFFERENT
VARIETIES OF CARBON.

BY M. BERTHELOT.

(ABSTRACT.)

THIS method consists of oxidising carbon at a low temperature and examining the product obtained. Under these conditions

1st. Diamonds, whether black or of the common kind, are not sensibly oxidised even by repeated and prolonged treatment.

2nd. The different varieties of amorphous carbon are completely transformed into humid acids of a yellowish brown colour, soluble in water. The properties of these acids vary according to the kind of carbon which produces them.

3rd. The different varieties of true graphite are changed into corresponding graphitic oxides; the properties of these oxides also vary according to the nature of the graphite whence they are obtained, but all are characterised by their insolubility and especially by their capability of being quickly decomposed, with deflagration, by the action of heat.

This is the mode of operation:—Mix with the powdered carbon five times its weight of chlorate of potassium previously pulverised, and gradually form into a sort of paste with fuming nitric acid; leave it for some hours in a small open flask, and then heat it for three or four days without intermission to about 50° or 60° C.; after this dilute it with water and wash by decantation with tepid water until the salts of potash are dissolved. It is generally necessary to repeat the process five or six times, or even more, in order to produce either of the results above mentioned.

The different varieties of carbon may thus be distinguished by studying the products of their oxidation. I believe this will also lead to the separation of graphites and amorphous carbons into several distinct groups, but this subject demands further inquiry. I propose henceforth to reserve the name of *graphite* exclusively to carbons which furnish a graphitic oxide, thus avoiding former ambiguities; the new mode of analysis is applicable not only to pure carbon but also to the mixed varieties.

1st. In the case of a mixture of amorphous carbon and diamond, the amorphous carbon is entirely dissolved after a few repetitions of the process, while the diamond remains unaltered.

2nd. In a mixture of graphite and amorphous carbon, the amorphous carbon is completely dissolved after repeated treatment, whilst the graphite gives rise to an insoluble graphitic oxide of a yellow or greenish yellow colour, decomposable with deflagration. The

graphitic oxide may be decomposed, as will be shown, in such a way as to cause the disappearance of the whole of the carbon.

3rd. In a mixture of diamond, graphite, and amorphous carbon, the amorphous carbon is entirely dissolved, leaving a mixture of graphitic oxide and diamond; this cannot be dissolved by solvents, but the diamond may be isolated as follows:—

Dry the mixture, then heat it in a tube closed at one end; the graphitic oxide is destroyed, leaving pyrographitic oxide; this reoxidised by chlorate of potash and nitric acid, forms soluble products, and a proportion of graphitic oxide much smaller than that first destroyed.

On decomposing this new graphitic oxide by heat, and then reoxidising the new pyrographitic oxide, only traces of graphitic oxide will be discovered. After three or four operations, the whole of the graphitic oxide will disappear, leaving only the diamond. Certain hard and crystalline powders formed by silicates or silica, and which occasionally occur as the last residue, must not be confounded with the diamond powder. The employment of fluorhydric acid, combined when needful with water and concentrated nitric and sulphuric acid, will cause the entire disappearance of this kind of residue.

Graphitic oxides and their derivatives form a special group, quite distinct from the ordinary combinations of organic chemistry. Let us now inquire what are the relations between these two sorts of compounds, and whether they are to be explained within the circle of analogies drawn from the study of other hydrocarbon compounds.

The transformation of graphitic compounds into ordinary organic compounds, say, carbides of hydrogen, is easily effected by heat and electricity; the different carbons and graphites, under the action of the electric arc, combine directly with hydrogen, and produce acetylene, a true organic compound capable of directly forming all the other organic compounds properly so called.

Carbides of hydrogen may also be formed with graphites by working with carefully managed reactions at a temperature not exceeding 280° . The same treatment must be used as with amorphous carbon, instead of working on the pure carbon, which cannot be combined at a low temperature with free or nascent hydrogen; begin by oxidising the carbon, and then introducing the hydrogenising action of iodhydric acid.

The oxides thus formed do not immediately produce carbides of hydrogen with the hydracid, which only changes them into hydrographitic oxides possessing special properties; but pyrographitic oxides, which are easily prepared by heating graphitic oxides, are nearer than these latter to the state of amorphous carbon, and therefore more easily oxidised or hydrogenised. By heating to 280° pyrographitic oxide from plombagine with 80 parts of iodhydric acid, I obtained hydrogen containing six hundredths of marsh gas. To ascertain the nature of the carburetted gas, I treated the gaseous mixture with absolute alcohol, determined the quantity dissolved, and made a comparative analysis of the gas undissolved and that dissolved, then re-evolved by ebullition, the latter consisting of a mixture of 36 parts of marsh gas and 64 of hydrogen. A suitable calculation founded upon the previous experiments, and upon the co-efficients of solubility, proved that the gaseous carbide was really marsh gas, C_2H_4 . However, the whole substance does not undergo the change

which produces the marsh gas; a considerable portion remains under the form of a black carbonaceous powder; the composition of this powder is also changed, for, when subjected to heat, it evolves a small quantity of inflammable vapour, which appears to be acetone. An addition of nitric acid and chlorate of potash will change this powder entirely into soluble products, with the exception of from 1 to 2 thousandths of graphitic oxide.

Pyrographitic oxides derived from cast-iron and electric graphite behave in exactly the same manner.

These facts show at once the speciality of constitution which distinguishes graphitic oxides from other organic combinations, and the conditions under which that speciality is gradually effaced, until the common order of combinations is regained. The difference must not, however, be exaggerated; it strikes us the more forcibly because we are led to compare graphitic oxides with gaseous or volatile hydrocarbons; this is not, in my opinion, the true mode of comparison. In the first place, the products of oxidation of graphites do not wholly differ from those of oxidation of amorphous carbon; both are fixed, and represent very condensed bodies; only the carbonic products are soluble, and the others insoluble. The passage from the characteristics of one group to those of the other becomes very apparent upon examining certain oxidised compounds derived from amorphous carbon; for instance, those derived from carbon produced by treating benzine or naphthaline with iodhydric acid. These products are dark yellow, amorphous, and precipitable by salts from their solution or aqueous emulsion, and are the intermediary compounds between graphitic oxides and those of amorphous carbon. These latter present much similarity to the products of oxidation of ulmic matter and other analogous condensed compounds.

The properties of graphitic oxides are not without analogy; their brisk decomposition is accompanied by the same formation of water and carbonic acid as in that of fixed acids and other highly oxygenated organic compounds. The lively evolution of heat which occurs at the same time may also be observed, though less intense, in the pyrogenated decomposition of acids and hydrates of carbon. Graphites, amorphous carbons, and their derivatives, may therefore be most suitably compared to hydrates of carbon and ulmic matter. In the series of gradual decompositions to which organic principles may be submitted, when decomposition occurs by molecular condensation, the brown and ulmic compounds immediately precede the carbonaceous substances, which appear still more condensed, and these again precede the carbons properly so called. The special structure of these compounds is demonstrated, not only by their origin, but also by the hydrogenising action of iodhydric acid, which reproduces saturated carbides corresponding with their generators, either the carbonaceous matters themselves, or the products of their oxidation.

The different varieties of amorphous carbon represent, therefore, certain polymeric conditions of the true carbonic element as it exists in the most widely disseminated hydrocarbonated combinations. The same conclusion applies to the different graphites. I shall show in my next that the most simple compounds of carbon are divided into two groups, according as they reproduce by their decomposition amorphous carbons, properly so-called, or graphitic carbons. All these substances must then be polymeric with the true car-

bonic element, as yet unknown, supposing it to exist in a free state and in a non-condensed form similar to that of the gaseous elements.

II. INFLUENCE OF SUNDRY AGENTS UPON CARBON ALREADY FORMED, AS HEAT, CHLORINE, IODINE, OXYGEN, AND ELECTRICITY.

1st. I did not succeed in passing from one group to the other under the influence of heat alone—that is, by calcining graphites and amorphous carbons at a white heat in an atmosphere of hydrogen. The amorphous carbon only appeared to augment in cohesion, whilst pyrographitic oxide, after calcination, does not yield more graphitic oxide than before.

2nd. Chlorine, at a white heat, does not change either wood charcoal into graphite or graphite into amorphous carbon; free carbon is well known to be unaffected by it. Iodine, at a white heat, does not change coke into graphite; it does, however, produce this transformation in nascent carbon at a red heat.

3rd. The action of oxygen causes simultaneously an extreme elevation of temperature, and the formation of carbonic acid and oxide of carbon. Carbon submitted to this double influence may be examined by lighting at a jet of oxygen, a pencil of retort charcoal, previously heated to redness. Whilst the point is in full incandescence, it must be quickly plunged into cold water to extinguish it; the extreme end of the pencil is then detached, taking only that part which has been most thoroughly heated. The carbon thus treated does not consist entirely of amorphous carbon, but also contains a small quantity of graphite, formed under the double influence of heat and oxidation. The same influences prevail in the case of incomplete combustion, when lampblack is formed; in this I have observed the presence of a trace of graphite; the occurrence of a similar trace of graphite in certain cokes is attributable, in my opinion, to the same cause.

These different results merit the more attention as it is possible that analogous phenomena may have played some part in the natural formation of graphite. To a similar origin has been attributed until now the formation of graphite and anthracite; but the result of my observations is, that the spontaneous decomposition of organic remains, even with the assistance of red heat, would furnish no plumbagine. The origin of the latter requires special explanation.

I have also examined the poles of carbon employed for the transmission of electric light. The powdered carbon, obtained by scraping a number of charcoal pencils which had formed the negative poles in producing electric light, was subjected to oxidation, and large quantities of graphitic oxide were thus obtained. This latter, and consequently electric graphite also, are identical with neither those of cast-iron nor of plumbagine.

The change which is here produced in the amorphous charcoal of gas retorts may also be seen in diamond. M. Jacquelin has demonstrated that diamond placed in the voltaic arc changes into a sort of coke. I was enabled to examine the same specimens which had been used in former experiments at the Sorbonne: the carbonaceous matter which had undergone oxidation was changed into graphitic oxide of the same kind as that of the charcoal from the retorts.

It was, therefore, probable that charcoal which had undergone the action of the voltaic arc would contain no diamond; this I carefully ascertained to be a fact, operating on considerable quantities of matter. None

of the specimens (obtained from the experiments made by Despretz upon sugar charcoal, with a pile of 600 elements) contained the least trace of diamond.

The formation of electric graphite does not occur indifferently at either of the electric poles. The negative poles only thickened by the passage of the carbon, furnish a large quantity of graphitic oxide, whilst the corresponding positive poles, thinned by the same phenomenon, contain only traces, which are probably due merely to the necessarily imperfect separation of carbon during the act of electric illumination. Transformation into graphite does not, however, require the previous volatilisation of the carbon; finally, capsules of sugar charcoal, softened by the heat of a pile of 600 elements, were found to be for the most part changed into graphite at the negative pole.—*Comptes Rendus*.

A NEW ELEMENT ACCOMPANYING ZIRCONIUM,

DISCOVERED BY MEANS OF
SPECTRUM ANALYSIS.

At the *soirée* of the Royal Society, on Saturday last, March 6th, Mr. H. C. Sorby, F.R.S., exhibited for the first time some phenomena in his spectrum microscope, which have led him to the conclusion that they are due to the presence of a new element, for which he has proposed the name of jargonium. The following is the account which Mr. Sorby then gave of this discovery:—

"Jargonium is an earth closely allied to zirconia, existing in small quantity in zircons from various localities, but constituting the chief ingredient of some of the jargons from Ceylon. It is, however, distinguished from zirconia and all other known elementary substances by the following very remarkable properties. The natural silicate is almost, if not quite, colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless both hot and cold, and no trace of absorption bands can be seen in the spectrum; but if the borax bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonium, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."

It appears, however, by the following communication from Professor A. H. Church, M.A., that a similar, if not identically the same, discovery was published nearly three years ago. Professor Church writes as follows:—

"Royal Agricultural College,
" March 6, 1869.

"I heard, when in London this week, that Mr. Sorby had discovered a set of black absorption bands in certain zircons, and had attributed their occurrence to the presence in the stones examined of a new element accompanying the zirconium. May I be permitted to refer your readers to the woodcut of these bands, which I published three years ago in the *Intellectual Observer* for May, 1866? The sketch was rough, and the cut badly executed, but it shows, though without the delicate shading of the original bands, the effect on solar light of its passage through a considerable thickness of a particular Ceylon zircon, or jargon, in my possession. Not only did I describe the bands, but I noticed their occurrence in the spectra of some

stones from particular localities (Ceylon), and their absence from stones from other localities (Espailly). I also added my views as to the cause of these bands—the presence of an element in some specimens, not found in others. I quote one or two sentences from the note referred to above:—‘I am induced to hazard the conjecture that it may be, after all, Svanberg’s *norium*, which determines the difference.’ ‘The absorption bands of zircon resemble those of didymium discovered by Gladstone, in their sharpness, and in their being produced by the passage of light through a colourless medium.’

“Since 1866, I have worked at intervals on the subject of the supposed *norium*. The rarity and costliness of the best and purest materials for the research—viz., transparent and flawless, and nearly colourless specimens—have seriously retarded the progress of my research. I have nothing ready for publication, but simply note the following points, which I have established with more or less certainty since the first conjecture which I made of an element different from zirconium in the ‘black-banded’ jargoons:—

“1. That zirconium is accompanied by at least one other metal (probably by two), in some of the zircons from Indian, American, and Norwegian localities.

“2. That the seven black absorption bands discovered in 1866 are characteristic of this new element, in some of its combinations at least, although I have not traced them definitely in any solution as yet.

“3. That the atomic weight of one of the new accompanying elements is different from that of zirconium.

“4. That the density of those zircons which show the black bands most intensely in the smallest thickness, is lower than that of those zircons which show no bands or only very faint bands. (In 1866, I showed that neither the direction in which the light was transmitted through the crystal, nor the action of an intense ignition, had any apparent influence on the particular absorptive power of the zircons for light now under discussion.) Of course comparison must be made with specimens in their native state and without flaws, or with specimens which have been similarly ignited, by which process the density is increased.

“5. The characteristic salts obtained from the black-band zircons may prove to have been included under those of *norium* by Svanberg. But as that term does not exclude some bodies which are certainly different from those which seem to belong only to the black-band zircons, a new name may have to be coined. *Nigrum* suggests itself as at once appropriate and consistent with the received system of nomenclature.

“I may add that the black bands were shown or described at the time of their discovery to many of my friends, among whom I may name Dr. Gladstone, Mr. Slack, and Mr. John Browning.

“Some of the zircons employed in my experiments are described in the *Chemical Society's Journal* for 1864 (November and December). The best was of a very pale greenish hue and without a flaw. It weighed 1.1665 grammes, and its density before ignition was 4.579, after 4.625. A rather smaller Espailly specimen was orange-red before ignition, and had a density of 4.863. After ignition it became colourless, but its density remained the same. In neither state did it exhibit any black bands, nor have I obtained from several ounces of the zircon from this locality any other salts than those of zirconia.”

Professor Church has forwarded the original drawing of the bands, torn out of his note book. From this the following woodcut has been engraved.



It appears only fair both to Professor Church and Mr. Sorby, that the original article in the *Intellectual Observer* for May, 1866, should be given together with the above more recent notes. We therefore reprint it as follows:—

“MICRO-SPECTROSCOPE INVESTIGATIONS.

“Letter from Professor Church.

“The Editor has received the following interesting letter from Professor Church:—

“‘Have you tried the experiment with chloride of cobalt, which I mentioned to you? If you take the saturated cold solution of this salt it will give the spectrum roughly sketched in Fig. 1,* a thinner film of the same solution, heated (on a glass slide with thin cover) over the candle or lamp gives the spectrum drawn in Fig. 2.† You will notice two black bands, I had almost said lines, in the red. As might be predicted from the change of colour on heating, the solution is afterwards much more transparent to rays beyond D. The chlorides of copper and nickel also give very interesting results.

“But I think you will be most pleased with the experiment I have now to relate. I have worked lately on the spectra of pleochroic minerals and salts. Among the minerals recently examined were several fine specimens of the true zircon or jargoon, a silicate of zirconia. These gave a beautiful and most characteristic system of seven dark bands quite different from those belonging to any other substance yet examined. They are roughly sketched in the following figure.‡ Zircons as colourless as common glass show these bands as well, perhaps better, than those possessed of colour. They are to be observed with zircons which have been ignited, as well as with those still in their natural condition. But some zircons show the phenomenon better than others, this difference not being due apparently to the colour of the stone or the thickness through which the light traverses. I am not quite sure, but I incline to think that those zircons which have come from some localities show the bands better than those from others. Several Espailly specimens scarcely exhibit anything of this kind; all those from Ceylon and Norway show the bands well. From this observation I am induced to hazard the conjecture that it may be, after all, the presence of Svanberg’s *norium* which determines the difference. You are aware that the orange jacinth, a variety of zircon, is very precious, and that the *essonite*, or cinnamon-garnet, is constantly sold for it. Curiously enough, the cinnamon-garnet, or *essonite* (a lime-garnet), has no conspicuous dark absorption bands at all, and so the spectroscope may be brought to bear upon the discrimination of these two stones. We have thus

* The figure alluded to shows the red darkened, the orange light, and a broad dark band commencing to the right of the yellow and extending beyond the line D; the remainder of the spectrum is cloudy.”

† Fig. 2 shows the narrow black bands in the red, modified tints replacing the broad dark band of Fig. 1, the blue coming out clear. The experiment is a very beautiful one.”

‡ The diagram referred to is substantially the same as the copy from Professor Church’s drawing printed above.

a much more ready process than that of taking the density of the specimens. The lime-garnet is of comparatively small value. The iron-garnet of different shades (carbuncle, almandine, &c.) gives a beautiful and very characteristic spectrum with several intensely deep absorption bands.

"I write these particulars of my experiments at once, for I thought you might like to make a little paragraph about them for the readers of the *Intellectual Observer*.

"I ought to add that the absorption bands of zircon resemble those of didymium, discovered by Gladstone, in their sharpness and in their being produced by the passage of light through a colourless medium. Silica, the other constituent of zircon, gives no bands."

The first who appears to have published researches on this subject is Svanberg. From his experiments he came to the conclusion that zirconia was not a simple earth, but a mixture of three, or perhaps even a greater number, of metallic oxides; and that these oxides are present in different proportions in the zircons obtained from different localities (*e.g.*, Siberia, Norway, and Ceylon), and in the hyacinth from Espailly in France. The atomic weight of these earths (supposing them to be sesquioxides) varies between 75 and 105.6, the mean of which, 91.2, is the atomic weight assigned by Berzelius to zirconia regarded as a simple earth. Svanberg could not succeed in completely separating these earths; but he found—1st. That the oxalate of one of them is less soluble in acids than the oxalates of the rest. 2nd. That the chloride of the radical of one of the earths is less easily soluble in hydrochloric acid than the corresponding compounds of the other radicals. 3rd. That the sulphate of one of them, when mixed with a large quantity of free sulphuric acid, crystallises much more easily than the sulphates of the rest, and likewise in a peculiar form. To the earth thus distinguished from the others with which it is associated, Svanberg gave the name of *noria*. This earth is likewise found in zircons from the Ilmengebirg. In the eudialyte from Greenland, Svanberg thought he had discovered (besides cerium, lanthanum, and didymium) two other earths, the first of which closely resembles yttria; the second has a yellow colour. According to Watts's "Dictionary," article "Norium," a subsequent experimenter, Berlin, throws doubts upon the composite nature of the earth commonly called zirconia. Now that attention is again directed to this subject, it is to be hoped that these doubtful points will be cleared up. There seems no lack of new elements waiting to be discovered, and further researches may show that Svanberg's *noria*, Church's *nigria*, and Sorby's *jargon*, are each separate entities.

Since the above was in type, we have received the following communication from Mr. Sorby:—

"36, Oxford Terrace, London, W.
"March 8, 1869.

"I send you an account of some of the objects I exhibited at the *soirée* of the Royal Society on Saturday, March 6th, illustrating the substance which gives such a remarkable spectrum.

"The specimen I showed was part of a *jargon* belonging to my friend, Mr. William Bragg, of Sheffield, who most kindly and liberally gave it to me for study. I soon found that the spectrum was not due to zirconia, since the zircons from some localities give no bands whatever: those from other localities show traces of the bands, as if they contained a small variable

amount of the substance in question, mixed with zirconia, in the same manner that many are variously coloured with small quantities of the oxides of iron. If the borax blowpipe bead of this substance had given absorption bands, in the same manner as the oxides of didymium, erbium, cobalt, and uranium, there would have been no difficulty in proving whether or no it was a new elementary body; but when melted with borax it gave a clear, colourless bead, when both hot and cold, without any trace of absorption bands. Very many known oxides give such beads, and the question was whether any of these would give the remarkable absorption bands when they were in a crystalline state.

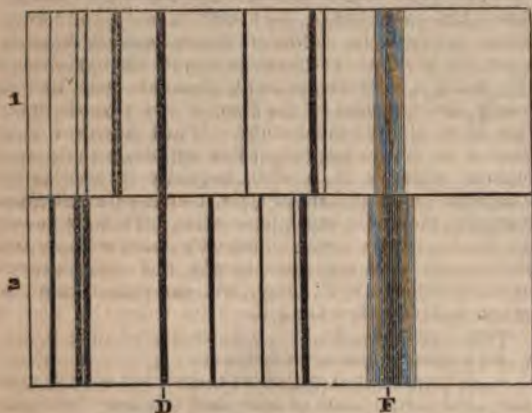
"There was no difficulty in proving that the crystalline silicates of a number of known earths and metallic oxides do not give any bands, but still a number of elementary substances could not be procured in combination with silica, or not in crystals sufficiently transparent to enable me to ascertain the fact for certain, though I prepared a large series of sections for this especial purpose. It was therefore open to doubt whether the substance which gave the bands was a new one or not, though I proved by my new blowpipe method that it was very closely allied to zirconia.

"At length it occurred to me that perhaps the production of the absorption bands depended on the substance being in a crystalline state, and I therefore saturated a borax blowpipe bead with it, and by flaming caused it to become full of minute crystals of the borate, so as to be white and almost opaque. By using a strong illumination, I succeeded in causing light to pass through the bead, and found that the spectrum then showed four absorption bands, very well marked, considering the nature of the case. None of these bands corresponded exactly with those of the silicate, and when microcosmic salt was added, so as to give rise to crystals of the phosphate, a spectrum was obtained with bands differing from both the others. The fact of the clear borax bead showing no bands until it is filled with crystals is, in my opinion, the most important yet discovered in connection with the subject, for it enables us to prove that the substance which gives the bands is no known earth or metallic oxide. Since it, therefore, appeared to be a new substance, and was found in certain specimens of the *jargon*, I thought no better name could be adopted than that of *jargon*.

"This was the state of my knowledge of the subject when I came to London a few weeks ago, bringing with me the printed description of most of these facts, to give away at the *soirée* of the Royal Society. My attention was subsequently called to Professor Church's letter in the *Intellectual Observer* for 1866, p. 291, which I had not previously heard of, since that work is almost unknown in the northern provinces. Judging from his description and figure, there can be no doubt that he had observed the spectrum of the same substance, only comparatively in a very imperfect manner, as will be seen by comparing his figure with that copied from my own drawing, shown at the Royal Society. He speaks of 'seven dark bands,' whereas my specimen shows double that number. He also says that 'all those from Ceylon and Norway show the bands well.' Now after having examined several hundred *jargons* from Ceylon, I must say that, in comparison with my own specimen, scarcely any show the bands well. There is not one single specimen in the British Museum that shows them even moderately well. One in the Museum of Practical Geology shows them in a satisfactory manner, and I have seen

others that show them, though not anything like so well as my own, the exact locality of which must be considered to be still unknown for certain. Those from Norway show the bands in the same comparatively imperfect manner as the usual specimens from Ceylon, and, even assuming that my specimen contains but little zirconia, we must conclude that the zircons from both those localities contain only a small amount of the substance for which I have proposed the name *jargonia*. If any one had only seen the usual kind of specimens from Ceylon or Norway, I can easily believe that he might have been led to conclude, with Professor Church, that the production of the bands might depend on the presence of Svanberg's *noria*. However, since the zircons from Norway (Frederikswærn), which, according to Svanberg, are so rich in his *noria* that it materially modifies the chemical equivalent of the earth and the specific gravity of the mineral, are, according to my own spectroscopic observations, so very poor in my *jargonia* that they give only a very faint trace of the bands, I cannot admit that they are the same substance. My friend, Mr. David Forbes, has most kindly allowed me to examine the zircons from many localities in Norway, collected by himself; and given me a number to cut for examination; and I find that none contain more than a decided trace of my *jargonia*.

"My own specimen of jargon is so rich in jargonia that a piece one-tenth of an inch in thickness, and all but colourless, gives fourteen bands, as shown in the accompanying figure. Unlike most other absorption bands, thirteen of these are narrow and perfectly black



lines, surpassing in this respect even those characteristic of salts of didymium. When the section is cut parallel to the axis of the crystal, though it is almost colourless with ordinary light, it is slightly dichroic, giving a reddish and greenish image. The reason of this is easily understood when the spectrum is examined with a double image prism, so as to give two spectra side by side with the light polarised in opposite planes, as shown in the accompanying figure. The image in which the light is polarised in a plane parallel to the axis of the crystal (No. 1) shows a well marked double band in the red which is absent from the other image (No. 2), whilst that shows a band in the yellow part of the green which is absent in the other. There is also a difference in the position of several of the bands, and a difference in the intensity of others, whereas that in the yellow is nearly the same in both. These are remarkable peculiarities, since in most dichroic substances

there is merely a difference in the intensity of all the bands.

"On the whole, therefore, it seems to me that these very striking absorption lines are due to an elementary substance not hitherto recognised, which can crystallise in all proportions as a silicate along with zirconia, and whose action on the spectrum varies to an unusual extent, according as it is in a vitreous state or crystallised in combination with different acids."

NOTE ON ARISTOTLE AND THE DISCOVERY OF THE WEIGHT OF THE AIR.

BY G. F. RODWELL, F.C.S.

IN the last number of this journal, M. l'Abbé Hamy has endeavoured to prove that, "before Galileo's experiment in 1643," the weight of air had been demonstrated by Aristotle. I alluded, in the *CHEMICAL NEWS* for Sept. 5, 1863* (*Eng. Ed.*), to the passage in Aristotle's treatise, *Περὶ Οὐρανοῦ*, to which M. Hamy refers, and there stated that, as the experiment was made by weighing a bladder of air in air, the increase in weight before and after inflation undoubtedly arose from the aqueous vapour introduced by blowing into the bladder. I still incline to this opinion, and I have no hesitation in saying that there is no reliable evidence to make it even probable that Aristotle discovered the weight of air.

I am at a loss to imagine to what M. Hamy refers in the phrase, "before Galileo's experiment in 1643;" first, because Galileo died in 1642; and, secondly, because the experiment in which he demonstrated, by direct weighing, that the air has weight, was made some years before his death; or, again, as to whether he refers to the Torricellian experiment, which was made in 1643.

M. Hamy bases his assertion on the following passage from Aristotle:—"Suo enim in loco gravitatem habent omnia præter ignem. Signum cujus est utrem inflatum plus ponderis quam vacuum habere." It is much to be regretted that he does not give the original text; but supposing the Latin translation to be correct, let us examine the statements. I am quite willing to cede the word *bladder* and to substitute for it *leather bag* or *bottle*, which *utrem* rightly signifies, if, as I suppose, the word in the original is *αὐτός*; but I would remind M. Hamy that Ptolemy the mathematician, who repeated the experiment, employed a bladder, as also did Simplicius, one of the most exact and careful of the many commentators of Aristotle. I have invariably seen the word rendered *bladder*, both by ancient and modern commentators. The verification of the statement that all bodies possess weight except fire, is furnished, says M. Hamy, by the experiment of Aristotle, "which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar, successively full and empty of air." Now, by what possible means *utrem inflatum* can be rendered an almost inextensible leathern jar I am at a loss to conceive. It is *inflatum*, hence it can exist in a state of non-inflation or the one word would not be required to qualify the other; neither could a leather jar full of air (which, if almost inextensible, it must be at the commencement of the experiment) be called *vacuum*, and the same, with more air blown into it, *inflatum*. This is the very perversion of accurate diction, and of sound Latinity. *Inflatum* and

* "On the Supposed Nature of Air Prior to the Discovery of Oxygen."

vacuum are evidently here used antithetically,—an inflated condition opposed to a non-inflated condition; full opposed to empty. It seems to me that a tight seamless bladder capable of withstanding some internal pressure, and of being readily closed by tying, would suit M. Hamy's purpose much better than "an almost inextensible leathern jar," if he be bent upon showing that Aristotle discovered the weight of air. A leather bottle may contain a liquid, but what can be less adapted to contain a gas under pressure? M. Hamy would have it filled by a blowpipe; by which means he believes that Aristotle "confined in his leathern jar more air than it would normally contain," and then weighed it. Granting that the leather jar would stand pressure without leaking, let M. Hamy take the maximum pressure at which air can be forced from the lungs, and then calculate the quantity of air which could be thus condensed into a vessel, and the volume of that air requisite to give weight recognisable by a rough statera, and he will see the impracticability of the experiment.

According to M. Hamy, scientific men have not given the glory of the discovery to Aristotle "because in endeavouring themselves to test the truth of the assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty." Let us hope many of them did fail; those who did not must have made an exceedingly gross error. Archimedes had proved that a body immersed in a liquid loses a portion of its weight equal to the weight of the liquid which it displaces, and this theorem applies here; since in the case of a bladder of air weighed in air, the air in the bladder loses *a priori* a weight equal to its own weight, it is clear that the bladder must weigh the same whether it be inflated or the reverse, and that the air weighs nothing in its own medium.

I can imagine how the demonstration of the weight of air was made by the philosopher who cared so little for the discovery of new truths. He is in the groves of the Lyceum in early morning, surrounded by pupils who are being instructed in acroamatics; he holds in his hand a leather bottle recently emptied of its Chian wine, or, perchance, the flaccid bladder of a Thracian bull, and, after a good deal of blowing, it is inflated and closed, Theophrastus, perhaps, acting as assistant (for he showed some taste for physics in after life). Then the inflated bladder is hung upon a clumsy statera, turning, perhaps, with the weight of half an Attic drachma, and the experiment is finished. But the students are not edified; they think it derogatory to study Nature, and one by one they wonder what their grandfather the Socratic would say to it all, or their father, who had sat at the feet of Plato.

We who deny that Aristotle discovered the weight of air are not "the philosopher's enemies," for this discovery would be almost a vanishing quantity when we consider how much he effected in other branches of knowledge; nor do we "strive to rob antiquity of its glories," for this discovery would add but little to an infinitely glorious past. Aristotle did not pretend to be an experimental philosopher; indeed, we question if he would thank M. Hamy for his disinterested attempt to make him one. Socrates and Seneca would have received such an imputation as an insult; the latter would have said (judging from some of his arguments in the "*De Vita Beata*")—"What matters it to me that the air has weight, I cannot alter it; let me rather strive to give weight to the actions of my life,

and to leave a something which shall sink through all humanity." But, supposing that the discovery of the weight of the air had been made by Aristotle, we should not regard him as one whit the wiser man; it was not an age for the discovery of physical truths; the world was not ready for them; Pneumatics would not have become a science one year sooner, Otto Von Guericke would not have teamed his sixteen horses to the great hemispheres of Magdeburg one day the earlier.

It is, I think, a most injurious practice to foist upon antiquity by means of vague and hypothetical premises discoveries which belong to a later age; and the reverse of this, which more frequently occurs, is equally pernicious. The transference of the merit of a discovery should never be attempted except upon the surest and most absolute grounds, and in the presence of indisputable facts. I say here, with M. de Strada—"L'activité humaine, si puissante, si immense, si agissante, qu'elle soit dans la connaissance, ne trouve j'amaïs en elle-même la certitude, mais la trouve toujours dans et par le fait." *

NEW APPLICATIONS OF THE MICROSCOPE TO BLOWPIPE CHEMISTRY.

BY H. C. SORBY, F.R.S.

OF these there are two chief divisions. In one method the substance is fused with borax or microcosmic salt, so as to give a clear bead, and the spectrum is examined by means of the spectrum eye-piece. In the other method the saturated borax bead is kept hot over the lamp, so that crystals may be deposited in it. By using a microscope many elements may then be easily distinguished by the form of the crystals, which are often of extreme beauty. When, however, much mixed, or combined with silica or other acids, as in natural minerals, it is often requisite to add various reagents—as phosphate of soda, microcosmic salt, boric, tungstic, molybdic, and titanous acids. These give rise to characteristic crystalline deposits; and we may thus distinguish lime, magnesia, baryta, and strontia, even when combined with silica; and can detect magnesia when mixed with several times its weight of lime, in impure limestone, &c.

Examples of this method:—

1. *Sphene*, melted with borax, does not deposit crystals; but the addition of boric acid sets free the titanous acid, easily recognised by the form of the crystals. Diluting the bead with more borax, so as to retain the titanous acid in solution, phosphate of soda causes the deposit of crystals of phosphate of lime.

2. *Fergusonite*, from Greenland, shows the spectrum of didymium, and from Ytterby that of erbium. When fused with borax, it deposits crystals of columbic acid; and after diluting with borax to prevent this, the addition of phosphate of soda produces crystals of phosphate of yttria.

3. *Gadolinite* from Ytterby, melted with borax, gives a spectrum indicating the presence of didymium and erbium; and when kept hot, it deposits the characteristic crystals of borate of yttria.

Numerous illustrations of this application were exhibited at the *soirée* of the Royal Society on Saturday last.

* "Philosophie Méthodique."

ON THE CRYSTALLISATION OF IRON.

DURING an examination of the Heaton process for making steel at Langley Mill, in which I have been lately engaged for the purpose of reporting thereon, I noticed a remarkable instance of the crystallisation of iron. After the violence of the action between the molten iron and the nitrate of soda had subsided, the lower portion of the apparatus, called the converter, is detached, and after a few minutes the contents are turned out in a porous mass of nearly $\frac{1}{4}$ of a ton in weight on to the floor. Upon examining portions of this metallic sponge, I find it consists of a segregation of minute feathery crystals of iron, apparently built up of small cubes. The outlines of some of these are perfectly sharp, and their appearance, especially in the cavities, is very beautiful.—*W. Crookes.*

ON THE

NON-PRECIPITATION OF MANGANESE

BY

SULPHIDE OF AMMONIUM IN PRESENCE OF SOME ORGANIC AMMONIACAL SALTS.

BY PROFESSOR HOW, D.C.L.,

WINDSOR, NOVA SCOTIA.

IN conducting the process of Reynolds (CHEMICAL NEWS, vol. ii., p. 208, *Eng. Ed.*) for the separation of iron and alumina, by precipitating the former metal by sulphide of ammonium, after addition of oxalic acid, I found that some of the manganese present remained dissolved along with the alumina. Unprepared for this retention, and failing to find any information as to the behaviour of manganese with sulphide of ammonium in presence of organic acids, I was led to experiment on this subject, and now give such of my results as seem to possess novelty and interest.

The oxalate of manganese recently described by myself (CHEMICAL NEWS, vol. xix., p. 41, *Am. Repr.*, March, 1869, page 122) appears to be much more soluble in dilute hydrochloric than in dilute sulphuric acid, and hence, doubtless, oxalic acid does not throw down the salt so soon or so abundantly from the chloride as from the sulphate of the metal. If a large quantity of oxalic acid is used with the chloride, and excess of ammonia and some sulphide of ammonium are quickly added, no sulphide of manganese falls, but the characteristic needles of the oxalate soon appear. When chloride, oxalate, and sulphide of ammonium are successively added to chloride of manganese, both sulphide and oxalate of this metal fall after a short interval. When the oxalate is dissolved in dilute HCl, successive addition of oxalic acid, ammonia, and sulphide of ammonium gives no precipitate of sulphide; and, on standing, crystals, consisting, no doubt, of an oxalate, are formed—perhaps the double salt mentioned by Gerhardt, and alluded to in my paper above cited. When solid tartaric acid is warmed in solution of $MnCl_2$, the subsequent addition of ammonia and sulphide of ammonium causes no precipitate. The same result is obtained when citric acid is employed. In both cases no manganese is thrown down on standing twenty-four hours.

The other metals of the fourth group fall, either at once or after a short time, as sulphides when the before-mentioned solutions retaining manganese dissolved in presence of sulphide of ammonium are added to their salts formed with mineral acids.

It does not appear that attention has been given to the deportment of manganese now described. Fresenius says the metal may be precipitated as sulphide from all compounds without exception (Quant. Anal., third English edition, p. 169), and mentions sulphide of ammonium as the proper precipitant (p. 170). H. Rose points out that manganese is not completely thrown down as sulphide, especially in liquids containing salts of ammonia (CHEMICAL NEWS, vol. ii., p. 302, *Eng. Ed.*), but he makes no mention of organic acids.

From the fact that oxalic and tartaric acids do not prevent the precipitation of sulphide of manganese by sulphides of the fixed alkaline metals, it seems that the joint presence of these acids and of ammonia (only) is necessary to retain the metal in solution on addition of sulphide of ammonium. I find that citric acid, dissolved in solution of $MnCl_2$, prevents precipitation on addition of potash and sulphide of potassium, and such solution, after standing twenty-four hours, precipitates sulphide of nickel from the nitrate of the metal immediately on its addition.

It would be interesting to enquire whether the retention of manganese now described depends on the production of manganos-ammonium, mentioned by Gerhardt, and alluded to in my paper on the oxalate of manganese referred to above.

ON FOOD.*

BY DR. LETHEBY, M.A., M.B., &C.

(Continued from *Am. Repr.*, April, 1869, page 192.)*Unwholesome and Adulterated Food.*

As regards vegetable foods, they are not so liable to decay or even to parasitic infection as animal foods; for the acari or mites of flour and sugar, or even the weevils of biscuit, are harmless; indeed, the most important infection of grain is the fungoid disease of it, called ergot. This is the muttermutter or roggenmutter of the Germans, and as it chiefly infests the rye, it is named, from its appearance, spurred rye; but it also attacks barley, oats, wheat, maize, rice, and most of the grasses. It always appears as a black grain, of a larger size than usual, and it is mostly found in plants which grow upon moist clay-soils, in damp situations, especially in the neighbourhood of forests. The district of Sologne, in France, between the rivers Loire and Cher, was once notoriously infested with the disease, and the Abbé Fessler, who was deputed in 1777 to investigate the causes of the extraordinary prevalence of ergot in that district, attributed it to the poor-ness and wetness of the land, and to the dampness of the air from the numerous forests. In bad seasons, as much as a third or a fourth of the crop was infected with ergot, and even in good seasons it constituted about two per cent. of it. The disease in the grain is due to the growth of a peculiar fungus, which the late Mr. Quekett named *ergotetia abortifaciens*, and the effects of it on the human body are very serious. It acts chiefly on the nervous system, causing giddiness, dimness of sight, loss of feeling, and twitching of the limbs, and death by convulsions; or it produces a creeping sensation over the surface of the body, with coldness of the extremities, followed by insensibility and gangrene. These effects are no doubt referred to by Ligeberth in his "History of Gaul and France," when he says that the year 1089 was a pestilent year

* The Cantor Lectures, delivered before the Society of Arts.

especially in the western parts of Lorraine, for many persons became putrid in consequence of their inward parts being consumed by St. Anthony's fire. Their limbs were rotten, and became black like coal, and they either perished miserably, or, being deprived of their putrid hands and feet, were reserved for a more miserable life. Bayle, too, in his account of this sickness, says that the bread was of a deep violet colour. The like effects have been observed in other parts of the Continent, as in Silesia, Prussia, Bohemia, Saxony, Holstein, Denmark, Switzerland, Lombardy, and Sweden, where the creeping sickness, as it is called, has attacked whole districts of the country, sparing neither old nor young, rich nor poor.

The remedy for the disease is in the hands of the miller, who should separate the ergotised from the healthy grains. Fortunately we have a ready test for its presence, not merely in the microscopic appearances of the flour, but in the circumstance that as it is the lightest of all the constituents of flour, it will float upon a mixture of one part of chloroform and six of alcohol, and will appear as a scum of dark-brown particles.

Another source of danger is the presence of poisonous grasses in the flour. The most important of these is darnel (*lolium temulentum*), which the careless or slovenly farmer will sometimes permit to overrun his fields, and the seeds becoming mixed with the corn, are ground into flour by the equally careless miller. The effect of the grains on man is to cause a species of intoxication, with headache, giddiness, somnolency, delirium, convulsions, paralysis, and even death. Occasionally it excites vomiting, with irritation of the alimentary canal, and then its effects are not so serious. Many instances are recorded of the poisonous action of the flour. Christison, for example, tells us, that a few years ago almost all the inmates of the poor-house at Sheffield, to the number of eighty, were attacked with analogous symptoms, after breakfasting on oatmeal porridge, and it was supposed that the effects were caused by the presence of darnel in the oatmeal. A similar accident is mentioned by Perleb, as having occurred at the House of Correction at Freyburg, and still more recently the same effects were produced on seventy-four persons at the workhouse of Benninghausen. Dr. Taylor states, on the authority of Dr. Kingsley, of Roscrea, that in the month of January, 1854, several families, including about thirty persons, suffered severely from the effects of bread containing the flour of darnel seeds. Those who partook of the bread staggered about as if they were intoxicated, and although they all recovered, yet they experienced a good deal of distress from giddiness, coldness of the limbs, and great prostration of the vital power.

Unripe grain, as well as grain affected with the rust, and mouldy flour and mouldy bread, have also produced disturbance of the human system. M. Bouvier attributed the epidemic of dysentery, which occurred in the department of the Oise, in the autumn of 1793, to the use of unripe grain; and corn affected with brown or black rust is thought by many to be unwholesome. Mouldy flour or mouldy bread is certainly injurious, for several instances are on record where not only men, but horses, have been poisoned by mouldy bread; and M. Payen has given a graphic account of the distressing effects of the mouldy ammunition bread supplied to the troops who were encamped near Paris, in 1843; the mould on that occasion was a yellow fungus, the *oidium aurantiacum*, but at other times it has been of a green colour, from *pennicillium glaucum*.

Mouldy food of every description is dangerous to use, and considering to what an extent the spores or sporidia of poisonous fungi are floating in the atmosphere, it is surprising that they do not more frequently taint our food and cause disorder of the system, for air washed with distilled water will always yield abundance of these germs, which are ready at any moment to spring into activity when they come into contact with a proper nidus for their growth. A remedy for these hidden sources of danger is good and effective cooking.

And now, in conclusion, let me make a few remarks on the subject of the fraudulent sophistications of food—a subject which has been very popular for the last fifty years, or rather, I should say, since the year 1820, when Mr. Frederick Accum published his treatise on "Adulterations of Food, and Culinary Poisons," with the startling motto from the Book of Kings—"There is death in the pot." As you may easily imagine, such a terrible announcement by a well-known writer, could not fail to excite alarm in the public mind, and to provoke anxious curiosity. The book, therefore, was eagerly sought for, and a thousand copies of it were sold within a month of its publication; so that, to use the words of the author, in his advertisement to the second edition—"there was sufficient inducement to reprint the work." The singular success of Accum's undertaking has been such a temptation to others, that the press has literally groaned with the efforts of sensational writers on the subject. And although I am ready to admit the importance of it, yet I am bound to state that it has often been grossly exaggerated, especially by those who have had but little practical knowledge to guide them.

The objects of fraudulent adulterations of food are threefold:—

1. To increase the bulk or weight of the article.
2. To improve its appearance.
3. To give it a false strength.

Among the first of these adulterations are the following:—

(a). The addition of inferior starches, as potato-starch or English arrow-root, curcuma or East Indian arrow-root, jatropha or Brazilian arrow-root, tacca or Tahiti arrow-root, canna or Tous-les-mois starch, sago-meal, &c., to true maranta, or West Indian arrow-root—of which Bermuda arrow-root is the most esteemed variety. A microscopic examination of the starch or fecula will always discover the fraud.

(b). The mixture of starch-sugar or even starch itself with common cane-sugar. Starch-sugar, or as it is sometimes called, grape-sugar, or glucose, is manufactured both in this country and on the Continent to a considerable extent. It is made from any description of starch, by boiling it for half an hour or so in water containing about one per cent of sulphuric acid. The acid is then neutralised with chalk, and the liquor evaporated to a density of 1.28. While hot, it is run off clear from the insoluble precipitate of sulphate of lime, and on standing in a cool place for a few days it crystallises or sets into a solid mass. This description of sugar has a low sweetening power—not half so great as that of cane-sugar—in fact, it is produced from the latter by the action of vegetable acids and heat, when cane-sugar is added to fruit in making a tart or fruit pie, and in making jellies and jams. It is false economy, therefore, to sweeten to any extent before the tart is baked. The sugar is known by many characters, as a want of sparkle from the absence of well-formed

crystals, its less solubility in water and greater solubility in alcohol, and by its giving a deep port-wine tint to a solution of potash when it is boiled with it.

(c). The dilution of milk, vinegar, &c., with water. This fraud is easily detected by the specific gravity of the liquid, and, in the case of milk, by the proportion of cream in the lactometer, and by the poor appearance of the milk when under the microscope.

(d). The mixture of dripping and other fats with butter, and water and starchy matter with lard. Butter and lard should always furnish, when melted, a clear-looking oil, with but little deposit of water or other substance.

(e). The addition of gelatine to isinglass, which is sometimes so well managed that it requires a skilful analysis to detect it. Isinglass is an organised substance, and when examined with the microscope, exhibits a peculiar structure which is very characteristic of it; not so, however, with gelatine. A particle of isinglass put into cold water remains opaque, like a piece of white bread, and does not swell out, whereas gelatine becomes transparent, and enlarges a good deal in bulk. Jelly made from good isinglass has a slightly fishy smell, and is neutral to test-paper, but that from gelatine has a distinct odour of glue and an acid reaction. Lastly, if a few grains of isinglass be burnt in a metal spoon until the ash alone remains—the ash will be very small in quantity, and of a reddish colour, while that of gelatine will be much larger in amount and of a white appearance. Gelatine never agrees with the delicate stomach of an invalid like isinglass; and, therefore, it is often important to discover the difference.

(f). Coffee adulterated with chicory is readily detected by sprinkling the mixture upon water, when the coffee, which is slightly greasy from volatile and fixed oil, floats, while the chicory sinks, and gives a brownish tint to the water. The experiment is easily made, as you here see, in a tumbler of water, and you may, with a little tact, determine the proportions of the mixture.

(g). Wheaten flour is frequently added to flour of mustard, and when the quantity passes beyond a certain amount, it is undoubtedly an adulteration, for the intention of it should be only to reduce to an agreeable extent the pungency of the mustard.

Of the second class of adulterations, where the object is to improve the appearance of the article, there are many examples, as:—

(a). The addition of alum to bread, by which, as I have already explained, inferior, and even damaged, flour may be made into a tolerable looking loaf. It is the property of alum to make the gluten tough, and to prevent its discolouration by heat, as well as to check the action of the yeast or ferment upon it. When, therefore, it is added to good flour, it enables it to hold more water, and so to yield a larger number of loaves; while the addition of it to bad flour prevents the softening and disintegrating effect of the yeast on the poor and inferior gluten, and so enables it to bear the action of heat in the process of baking. According to the quality of the flour will be the proportion of alum, and hence the amount will range from 2 oz. to 8 oz. per sack of flour. These proportions will yield from 9 to 37 grains of alum in the quartern loaf, quantities which are easily detected by chemical means. Indeed, there is a simple test by which much smaller quantities of it may be readily discovered. Infusion of logwood, as you here perceive, acquires a rich purplish carmine, or

claret tint, when it is brought into contact with alum; you have, therefore, only to dip a slice of the bread for an instant, as I am now doing, into a weak, watery solution of logwood, and if alum be present the bread will speedily acquire a purple or reddish purple tint. I have already described to you the other properties of good bread, as that it should not exhibit any black specks upon the upper crust; it should not become sodden and wet at the lower part by standing; it should not become mouldy by keeping in a moderately dry place; it should be sweet and agreeable to both taste and smell; it should not give, when steeped in water, a rosy acid liquor; and a slice of it taken from the centre of the loaf should not lose more than 45 per cent by drying.

Sulphate of copper is found to act like alum in improving the appearance of bread; and, according to Kuhlmann, Chevallier, and others, it is commonly used by the bakers of the Continent, notwithstanding the severe penalties attached to it. In this country, however, it is but rarely employed.

(b). The bloom, or glaze, or facing of green and black tea is generally artificial. In the case of green tea, it is ordinarily a mixture of Prussian blue, turmeric, and sulphate of lime, or China clay; and in that of black tea it is not unfrequently a coating of black-lead. The tea prepared for the English market is notoriously subject to these adulterations; and it seems that it arises entirely from our own fancy, and not from any desire on the part of the Chinese to pursue such a practice. The adulteration is easily discovered by shaking the tea with cold water, and then straining through muslin, and allowing the fine powder to subside.

(c). Pickles and preserved fruits are often made green with a salt of copper, it being the peculiar property of that metal to mordant, or fix in an insoluble form, the green colouring matter or chlorophyll of vegetables. If, therefore, the pickling operation is conducted in copper vessels, or if a little verdigris or sulphate of copper is added to the vinegar in which the vegetables are boiled, the colour of them will be retained. In some cases the quantity added has been so large as to give a coppery look to a steel fork or knife plunged into the pickle. In such cases, as might be expected, severe symptoms of poisoning have been occasioned by it.

(d). Ferruginous earth, or red oxide of iron, is frequently added to sauces, to anchovies, to cocoa preparations, and to preserved or potted meats, to improve their appearance.

(e). Mineral pigments, often of a poisonous nature, are used in colouring confectionery.

And lastly, with the view of giving a false strength to the article, we have instances of sulphuric acid added to vinegar, black-jack or burnt sugar to coffee and chicory, catechu or *terra japonica* to tea, *coccus indicus* to beer, cayenne to peppers, &c.

That many of these sophistications are dangerous there can be no doubt, and all of them are frauds on the public. Parliament has therefore attempted to deal with the matter by legislation, as in the "Act for Preventing the Adulteration of Articles of Food or Drink" (23rd and 24th Vict., cap. 84) of 1860; but as the act is only permissive, little or no effect has been given to it. Even in those places, as in the City of London, where it has been put into operation, and public analysts have been appointed, no good has resulted from it; in fact, it stands upon the statute-book as a dead letter. Speaking for the City, I may say that every

inducement has been offered for the effective working of the act, but nothing has come of it. In olden time the remedies for such misdemeanours were quick and effectual. In the *Assisa parva*, for example, as set forth in *Liber Albus*, there are not only the strictest regulations concerning the manner in which the business of the baker is to be conducted, but there are also the penalties for failing in the same. "If any default," it says, "shall be found in the bread of a baker in the City, the first time let him be drawn upon a hurdle from the Guildhall to his own house through the great streets where there be most people assembled, and through the great streets which are most dirty, with the faulty loaf hanging from his neck; if a second time he shall be found committing the same offence, let him be drawn from the Guildhall through the great street of Cheepe, in manner aforesaid, to the pillory, and let him be put upon the pillory, and remain there at least one hour in the day; and the third time that such default shall be found, he shall be drawn, and the oven shall be pulled down, and the baker made to forswear the trade within the City for ever." It further tells us that William de Stratford suffered this punishment for selling bread of short weight, and John de Strode for making bread of filth and cobwebs. One hoary-headed offender was excused the hurdle on account of his age and the severity of the season; and it would seem that the last time the punishment was inflicted was in the sixteenth year of the reign of Henry VI., when Simon Frensshe was so drawn. A like punishment was awarded to butchers and vintners for fraudulent dealings; for we are told that a butcher was paraded through the streets with his face to the horse's tail, for selling measly bacon at market, and that the next day he was set in the pillory with two great pieces of his measly bacon over his head, and a writing which set forth his crimes. In the judgments recorded in *Liber Albus* there are twenty-three cases in which the pillory or the stew was awarded for selling putrid meat, fish, or poultry; thirteen for unlawful dealings of bakers, and six for the misdemeanours of vintners and wine-drawers. Of a verity we have degenerated in these matters.

And now, in conclusion, having directed your attention to the nutritive values of different kinds of food; to their functional and dietetical powers; to the modes in which they are associated; to the quantities required for ordinary labour; to the manner in which they are digested; to the effects of culinary and other treatment; to the way in which they may be preserved; and to the causes of their unwholesomeness, we may finally ask if any great generalisations can be deduced from our inquiries?

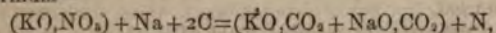
In the first place, you will, I think, have observed that there are very striking evidences of design in the way in which organic matter is constantly kept in motion, for, whether living or dead, it is always in a state of molecular activity—either advancing towards the highest state of organisation, or retreating to the confines of the mineral kingdom. The result of this is that, with a comparatively small amount of material, and with but little expenditure of force, the work of the living world is fully and effectively performed. Starting from the mineral kingdom, as carbonic acid, water, and ammonia, the elements of organic nature pass through a succession of changes, first in the vegetable and next in the animal, until they reach the summit of organisation, when they again return to their primitive condition. In this manner a never-

ending round of change is perpetuated, and the same material and the same force are kept moving in the same continuous circle. Through the efforts of the plant the crude materials are formed into vegetable acids, sugar, gum, starch, fat, albumen, and tissue; and then the animal converts them into higher forms of structure, as gelatine, muscle, and brain; the two extremes, therefore, of these changes are, to use the words of Gerhardt, carbonic acid, water, and ammonia at one end; albumen, gelatine, fat, and cerebral matter at the other—but the transitions to these extremes are countless, and are as yet beyond the reach of science. Broadly, however, we may say that the chemical functions of the plant are those of reduction or deoxidation, whereby carbonic acid and water are deprived of their oxygen and moulded with nitrogen into food; while those of animals are of an opposite nature, for they destroy this food by oxidation. The plant, therefore, is the machine or medium whereby carbonic acid, water, and ammonia are converted into new compounds, and light and heat are transformed into chemical affinity; and the animal is the medium or machine whereby these compounds are destroyed, and their affinities changed into other manifestations of force, and finally into heat. In this way, the circuit of change is completed; and it is not difficult to trace the phenomena of vitality to the cosmical forces which the plant had imprisoned. But shall we ever be able to follow, through all the intricacies of change, the countless transitions of both matter and force in their passage from the mineral kingdom to the animal, and then back to the mineral again? It is easy to connect, by a correlation of force, the muscular movements of the animal body, and even the highest efforts of the human mind, with the sunbeam which the plant had arrested; but shall we ever be permitted to unravel those mysterious functions, those intermediate changes which constitute the phenomena of life? Why is it, for example, and how comes it, that the living cell of the plant is able to aggregate mineral matter in opposition to the common laws of affinity, and can transform light and heat into cell-force? How is it, too, that the animal, in reversing the process, and so restoring the play of affinity, is able to transmute it into other manifestations of force? At present, the utmost we can say of it is, that organic matter is the appointed medium of all these changes, and is designed for the exhibition of vital phenomena, just as mineral matter is the appointed medium for the phenomena of electricity and magnetism; and yet to some extent, perhaps, we are able to penetrate the mystery; for, by finding the clue to the peculiar action of the vegetable in reducing chemical compounds, we can, by operating on such substances as carbonic acid, water, and ammonia produce a large number of organic principles; in fact, of the three great classes of alimentary substances, to which I have so frequently directed your attention—namely, the oleaginous, the saccharine, and the albuminous—it may be said that the first is already within the manufacturing power of the chemist, and the second is nearly within it; so that there is abundant proof that the agency of a vital force is not necessary to the formation of organic compounds; and there is even hope that the fabrication of food may not be altogether beyond the capabilities of man.

(To be continued.)

ON THE SUBSTITUTION OF SODIUM FOR PHOSPHORUS IN LUCIFER MATCHES.

DR. H. FLECK, of Dresden, has instituted a series of experiments with the view to obtain a non-poisonous paste for the application to lucifer matches. He ascertained, by some preliminary experiments, that sodium, when minutely divided along with explosive substances, becomes highly inflammable when simply moistened with water. A mixture, constituted according to the formula—



formed a greyish-coloured mass, which, on being touched with a moistened glass rod, ignited like gunpowder; this mixture was, however, found to be unfit to ignite ordinary brimstone matches for a cotton wick soaked in petroleum. In order to mend this defect, black sulphuret of antimony was substituted for the charcoal, according to the formula $3(KO, NO_2) + Na + (SbS_2) = (NaO, SbO_2) + 3(KO, SO_2) + 3N$, and the mixture made up of—

0.5 grammes of sodium	.....	=	4.65 per cent.
66.0 " nitrate of potash		=	61.39 "
36.5 " sulphide of antimony		=	33.96 "

Provided that during its manufacture this mixture is kept thoroughly dry, it has been found to answer admirably well. The mode of making it up is briefly as follows:—Pure solid paraffin is put into a well-stoppered glass flask, and melted over a sand bath, when fluid, clean pieces of sodium are added, and liquefied under the paraffin. As soon as the metal is thoroughly liquefied, the flask is closed and shaken for about ten minutes, which has the effect of granulating the metal, or rather reducing it to a fine powder. The metal is then poured out of the flask along with the paraffin, and the sodium taken out of the paraffin by means of a clean dry spoon; from 30 to 35 per cent of paraffin remains adhering to the metal; this, however, does not impair its inflammability, while it tends to preserve the metal. Owing to this increase, instead of 5 grammes, 6.6 grammes of the metallic powder thus obtained must be weighed off. The incorporation with the other ingredients, previously well dried and warm, is effected under petroleum in metallic mortars, but each of the substances is first mixed with some petroleum, and pulverised separately before being triturated with the sodium; instead of gum or glue, caoutchouc, previously soaked in light petroleum oil at 110° C. for ten or twelve hours, is used as mass to form an adhesive paste with the other materials. According to several accounts from Germany, this plan of substituting sodium for phosphorus has been favourably taken up by some of the largest and leading manufacturers of lucifer and fusee matches. There is said to be not the least danger in the transport.—*Abstracted from Deutsche Industrie Zeitung.*

ON THE PRESERVATION OF TIMBER.*

BY P. M. MOIR.

THE preservation of timber is of great practical importance—its preservation is alike valuable to the student, the practical worker, and the capitalist; and it is not to be wondered at that many minds have been directed to solve the question whereby decay may be arrested, and the timber preserved and made as durable as the other parts of the construction it may be in union with.

* Abstract of a paper read before the Glasgow Philosophical Society (Chemical Section), Feb. 1, 1869.

A very common and destructive kind of decay is dry rot, which is often very rapid in wasting the substances of timber, more particularly in such places as are free from a circulation of air.

There is another familiar agent deadly to timber, which we in this country are not acquainted with, but which is the cause of great destruction in India, Ceylon, Brazil, and all tropical countries, where it is very abundant. I refer to the white ant, or termite. Its attacks are most ravenous on all wood buildings, railway sleepers, and bridges, although the material used in the latter be of *lignum vite*, a very hard and durable wood.

Timber used for marine purposes is subject to the attacks of the *Teredo navalis* and *Limnoria terebrans*. Greenheart timber, in its natural state, is the only wood now in use for harbour works that is free from the attacks of marine worms and insects, and the white ant in tropical countries.

There are two reasons why this timber resists the ravages of these insects—1st, its hardness; 2nd, it contains a large quantity of essential oil.

I now come to the various methods that have been adapted and tried for the preserving of timber, both from natural decay and destruction, mentioned—and these have been mechanical and chemical.

The mechanical have been wholly applied for marine purposes, and are the oldest in use. The first, I may mention, consisted in covering piles, between high and low-water mark, with flat-headed iron-nails, the heads being about 1 inch in diameter, driven into the wood as close to one another as they could be put without overlapping; the water soon acted upon them by corrosion, which penetrated the skin of any portion of the wood not covered by the nails. This process is very expensive, not only in the materials used, but the amount of labour required driving in the nails.

Another plan was to cover the piles with sheets of zinc or copper.

I next come to the chemical processes that have been tried, and are still in use, for preserving wood.

Upwards of fifty patents have been taken out for preserving animal and vegetable substances, including timber, many of which have never been worked practically; in fact, there are only six that I am acquainted with that have been worked commercially—Kyan, 1832; Margary, 1837; Bethell, 1838-48; Burnett, 1838-40; Payne, 1841-46; Boucherie, 1839.

These patents were obtained for the application, either by steeping or filling the pores of timber by pressure in close vessels with solutions of different chemical agents; excepting Boucherie's, and he latterly adopted the salt used by M. Margary—viz, the sulphate of copper.

PATENTS.

Kyan	1832	Chloride of mercury.
Margary	...1837	Sulphate of copper.
Bethell	{ 1838 } { 1848 }	Creosote, or pitch oil.
Burnett	{ 1838 } { 1840 }	Chloride of zinc.
Boucherie	{ 1839 } { 1846 }	Pyrolignite of iron. Sulphate of copper.
Payne	{ 1841 } { 1846 }	Sulphate of iron. Carbonate of soda.

In the working of these patents practically, there were three different methods used in the application—viz, steeping, vital suction, and pressing in close vessels. The first of these was adapted by Kyan and

Margary, the second by Boucherie, and the third by Payne, Burnett, and Bethell, and latterly by Boucherie. In the first and third methods, the several processes required the timber should be seasoned and free from sap.

Kyan's process was the mixing of chloride of mercury, in proportion of 1 lb. of salt to 5 gallons of water.

Margary, in 1837, obtained a patent for preserving timber, ropes, canvas, cloth, &c., by soaking them in a solution of sulphate of copper.

Payne, in 1841, obtained patent rights for a process for preserving timber. His plan was the production of a double decomposition in the pores of the wood, by first injecting a solution of some metallic body, such as sulphate of iron, which was forced into the wood under pressure, in iron cylinders; after the wood had absorbed the quantity required, the surplus liquor was drawn off, and a solution of carbonate of soda forced in, which fixed the iron in the cellular tissues of the timber, forming oxide of iron.

Sir William Burnett took out a patent in 1838 and in 1852; the latter was an extension of his patent rights for seven years. His patent was for the preservation of timber, canvas, cordage, cotton and woollen cloths, &c., with a solution of chloride of zinc ($ZnCl$), the proportion used being 1 gallon of the concentrated solution to 40 gallons of water.

I have now to bring before your notice the last of these patents—viz., Bethell's process for preserving timber with creosote, or pitch oil. This invention differs entirely from all the others, in so far that the oil used is not only a most powerful coagulator of albumen, but it likewise preserves the fibre of timber. Of all processes for preserving timber, this one seems to have found most favour, as it has been universally used, not only in Great Britain and Ireland, North and South America, India, and all continental countries in Europe, wherever railways have been constructed, but also in harbour works, for which it is especially applicable in resisting the attacks of marine worms and insects. Many patents have been obtained for the use of oleaginous substances in preserving timber, but none were brought into practical use until Bethell procured his in 1838. In some instances cylinders are open at both ends, and closed with iron doors, so that sleepers or timber entered at one end, on being treated, can be delivered finished at the opposite end. I have found, however, for all practical purposes that one open end is sufficient, as the oil when heated, being of such a searching character, it is a difficult matter to get the doors perfectly air-tight, consequently they are apt to leak during the time the pressure is being applied. Pipes are led from the cylinder to the air and force pumps; the air is not only extracted from the interior of the cylinder, but also from the pores of the timber. When a vacuum is made, the oil, which is contained in a tank below the cylinder, is allowed to rush in, and as soon as the cylinder is full, the inlet pipe is shut and the pressure pumps started, to force the oil into the wood; the pressure maintained is from 150 to 200 lbs. to the square inch, until the wood has absorbed the required quantity of oil, which is learned by an index gauge fixed to the working tank below. All cylinders are fitted with safety-valves, which allow the oil not immediately absorbed to pass again into the tank. The oil is heated by coils of pipe placed in the tank, through which a current of steam is passed, from end to end, raising the temperature to 120° F. The

quantity of oil recommended by the patentee, engineers, and others, is 8 lbs. of oil for land purposes, and 10 to 12 lbs. to the cubic foot for marine. In this country, for marine the quantity does not exceed 12 lbs.; but on the continent—in France, Belgium, and Holland—the quantity used is from 16 to 26 lbs. per cubic foot. Beech has absorbed as high as 31 lbs. of oil per cubic foot, and when used for planking, either for railway platforms or harbour works, is, without doubt, the cheapest and most durable material that can be used.

I estimate the possible yield of pitch oil in Scotland at 1,000,000 gallons; this is mostly all used for creosoting purposes; latterly a portion has been applied for fuel burning under steam boilers. It is slightly soluble in water, consequently it could not be used for out-door purposes in its pure state; it requires to be mixed with oils, or the other portions of the creosote, which fill up the pores of the timber, which, on exposure to the air, solidifies, giving the wood a coating, and making it impervious to water and the action of the atmosphere.

In the new edition of Dr. Ure's "Arts and Manufactures," under the head of "Wood Preserving," it is stated that Bethell's process "produces perfect coagulation of albumen in the sap, thus preventing its putrefaction."

In a letter written by Dr. Letheby, extracted from the *Journal of the Society of Arts*, after describing the action that takes place when timber is prepared with creosote, he concludes his letter by stating that the preservative action is of four kinds:—

1st. It coagulates albuminous substances, and gives stability to the constituents of the cambium and cellulose of the young wood.

2nd. It absorbs and appropriates the oxygen which is within the pores of the wood, and so checks, or rather prevents, the eremacausis of the ligneous tissue.

3rd. It resinifies within the pores of the wood, and in this way shuts out both air and moisture.

4th. It acts as a positive poison to the lower forms of animal and vegetable life, and so protects the wood from the attacks of fungi, acari, and other parasites.

The creosoting process since it was first introduced in 1838, has been extensively employed in Great Britain and Ireland, and in all countries on the continent of Europe where creosote oil can be economically procured; wherever it has been properly carried out, it has been completely successful.

Of late, many railway companies have discontinued the creosoting of their sleepers, not on account of any failure in the process itself, but from the wear and tear of the chair cutting down into them, and gradually rendering them useless. This would not have been the case, to a great extent, had the base of the chair been broader, which would have prevented the mechanical action of sinking into the wood, and enabled the sleeper to have lasted much longer.

In India, and elsewhere abroad, where damp, dry rot, and insects destroy unprepared sleepers so rapidly, I say by all means creosote; and for all soft wood timber used in the construction of piers, bridges, and similar works, I say the same. Creosoting being a preservative against the attacks of the white ants in India, great numbers of creosoted fir sleepers were sent out from England. These creosoted sleepers were found to be very durable. The fir wood itself is perishable in India, probably from the heat evaporate rapidly serving it.

kinds of insects, even when the wood is most exposed to their attacks.

In the report presented by the Minister of Public Works in Belgium, in May, 1863, to the Legislative Assembly, respecting the operations of the State Railways in the year 1862, at page 12 it is stated as follows:—

"In 1862 a special commission was instituted to determine the state of preservation of the sleepers, which, before being put into use, have been the object of preparations destined to prolong their duration. The result of this commission has been to persuade the Government to give up entirely the process Boucherie, and for the future to abide by the using—1st, of oak sleepers in their natural state, or which have been submitted to the preparation of the creosote oils by system Bethell; 2nd, of beech sleepers or red pine, prepared after the same process."

At page 86, a statistical table is published showing the numbers used between the years 1835 and 1863, in which table is stated that the average duration of unprepared oak sleepers is 11½ years, and of unprepared fir sleepers, 7½ years.

In the spring of 1865, a very careful examination was made by the authorities of all the creosoted sleepers, and they found that all these sleepers (although some of them had been in use 19 years) were perfectly sound and fresh, and, in consequence, the Belgian Government decided to have all their sleepers creosoted in future.

The annual Government report on the Belgian State Railways, for the year 1864, states:—

"123,397 sleepers, prepared by Mr. Bethell's process, were laid down; and 16,205 prepared by Boucherie's process (sulphate of copper); and 1,869 sleepers prepared by various other processes, were taken up.

"The administration, looking to the results of past years' experience, continues to confine itself to oak sleepers and creosoted sleepers for making or relaying its lines, as the superiority of Bethell's system over all others appears to be an established fact. Out of the 153,753 new sleepers put down in 1864, 128,165 were creosoted, and only 25,588 were unprepared oak."

For marine purposes it is the only process now acknowledged by engineers to be applicable for preserving timber from the attacks of the *Teredo* and *Limnoria*. For harbour works in Scotland this process has been largely used. At Leith, the west pier is entirely constructed of creosoted timber, consisting of 1013 main piles; the extension of the east pier also consists of 312 main piles creosoted. These erections were commenced in 1848, and finished in 1853, and at the present time they are all as perfectly sound as the first day they were put down. The gates of the new dock, now being constructed at that port, are of creosoted pine bound with greenheart. The quantity of oil used was 10 lbs. per cubic foot. At Glasgow, all the wood-wharfs, with exception of the steam-boat quay, are constructed of creosoted pine; 8 lbs. of oil being injected to the cubic foot. The whole of the wharves at Kingston dock, are entirely of creosoted wood, the same quantity of oil being used. At Port Glasgow and Greenock, timber prepared by this process is largely used, and at nearly every port in England.

Of late, several other processes have been patented for preserving timber.

Robbins's is to put the timber into iron chambers, and passing the vapours obtained from the distillation of coal tar into the chambers, and allow the timber to absorb the same without pressure.

The Resin Process.—The timber is first boiled in a weak solution of carbonate of soda, and then treated with liquid resin in close tanks heated to 306°.

Beerziny's is another process, and, as described by the patentee, he removes the sap of timber by boiling in water to which borax is added.

LECTURES.

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(FULLERIAN PROFESSOR OF CHEMISTRY IN THE ROYAL INSTITUTION.)

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

(Concluded from Am. Repr., April, 1869, page 200.)

HERE is a jar full of carbonic gas, the presence of the gas being shown by the immediate extinction of a lighted taper; the jar is apparently empty, but in reality it is full of gas. If I wanted to empty it of any liquid it might contain, there are several methods to which I might have recourse; of course the most obvious one would be simply to pour it out. I will first see if I can pour anything out of this jar on to the taper. [The jar was tilted over a lighted taper, which was at once extinguished by the invisible gas.] You see we have poured something out. We will try it in another way. Here is a bottle of lime-water, and we will see whether we can pour into it any gas from our jar. I just hold our apparently empty jar over the lime-water, and then shake up the lime-water, and you see it is at once converted into a mixture of chalk and water; this is the most usual way of getting a liquid out of a jar. There is another method, to which we may very easily resort. I will pour out some of the gas upon the candle in another way; I first pour some of it into a beaker, and then from the beaker on to the candle, which is thus at once extinguished. This is another illustration of the mode of getting this heavy gas out of the jar—by simply pouring it. Now we will adopt some other methods. I again light the candle, and, instead of pouring out the gas, I will bale it out. I take a glass cup, and introduce it into the jar of carbonic gas, thus abstracting a quantity of it, which I will pour from the cup into the lime-water; I then shake up the lime-water, and you see that I have in this way actually conveyed some of the gas into the bottle of lime-water. Now I will try whether some more of the gas can be baled out from this jar, and a candle extinguished with it. I fill the cup with the gas and pour it upon the candle; and you see that at once the flame goes out.

If I wanted to empty out of a large jar like this, any liquid it might contain, I could, as I have reminded you, pour out the liquid as I did at first, or I could bale it out; but there are other methods still which might be employed. You must all be familiar with the syphon, and you have, no doubt, seen it in use in the streets, in front of public houses, for the purpose of drawing off spirits from the casks into the large measures. Now let us try whether we can in the

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same way remove any carbonic gas from this jar; we will first fill our syphon, and then see if we can syphon off the gas. I apply the syphon; and you perceive that, by its means, we can cause the gas to flow upon the candle, and at once put it out. I now take a little lime-water, and upon this I allow the syphon to empty itself for a few instants. [After a short pause]—It has gone on long enough, I have no doubt. I therefore place the stopper in the bottle of lime-water, and, on shaking it up, the lime is immediately converted into chalk. I have syphoned off the gas, and this proves to you that it is heavy, and can be treated like a liquid; we can either pour it out, bale it out, or syphon it out.

Now let me give you one or two further illustrations of the weight of carbonic gas, and for this purpose I will take it as it is contained in soda-water. Here is an empty bottle,—that is to say, a bottle containing nothing but air; I will pour into it some clear lime-water, and then endeavour to act upon that lime-water by the gas evolved from our bottle of soda-water, and at the same time I shall have an opportunity of showing you the weight of the gas. I have already once or twice put out a candle by the gas evolved from soda-water, and this experiment I intend to repeat; but this time I will pour the gas upon the candle, and so show you its weight. When I extinguished the candle by means of the gas from soda-water, we had not considered the weight of the gas. I just open the soda-water bottle, carefully, and first I will try the action of the gas upon the lime-water. I take a funnel, and into it I pour some of this carbonic gas that it may descend into the lime-water. I simply pour the gas, without any of the water which is contained in the bottle, and you see that we have formed a reasonable amount of chalk by means of the gas that we have thus poured upon the lime-water. [The lime-water was shaken, and became turbid, indicating the presence of carbonic gas in the bottle.]

Now let me call your attention to another mode of getting out this gas, and for that purpose I will use this larger cylinder, which is now being filled with the gas from the supply down stairs; we will ascertain whether the jar is full. You see it is so, for on introducing the taper, the light is at once extinguished. You know that another very common way of emptying a large vessel of water is to use a tap. Now here is our large jar really full of gas, although it looks as if it were empty. I just close the tap by putting my finger upon it. We will first of all draw off a little of the gas over a bottle of lime-water, into which I now let some of the gas run. I have no doubt that the bottle now contains sufficient for our purpose. I shake it up, and you see we get a similar result to what we did with the soda-water. I will take another bottle, and this time, instead of allowing the gas to run directly into the bottle, I will let it run into the beaker so as to fill it, and then I will pour its contents into the bottle. I hold the glass beaker carefully under the tap so as to catch the gas, and now that it is sufficiently full I close the tap with my finger, and pour the gas contained in the beaker into the bottle. I shake up the bottle, and here again you see our clear lime-water is converted into a mixture of chalk and water. I will now allow the gas from the tap of the jar to flow upon a candle, and you see that as it does so the flame is at once extinguished by it. Here is another candle, upon which I will also let the gas pour down, and I may call your attention at the same time to the force with which it issues from the jar. You see that in this instance it blows out the flame of the candle before completely extinguishing it in its usual way. I will now allow the carbonic gas to fall upon a flame of ordinary coal gas, and in this case also the flame is extinguished. Now I will endeavour to catch some of this gas by letting it pour into a beaker, and then try to pour it from the beaker on to a candle. You see our vessel was completely full, for when I pour the gas on to the candle the flame immediately goes out. I will now give you another illustration of the weight of the gas. In this instance,

instead of bringing the candle to our barrel, I will bring the barrel to the candle. Having done so, I remove my finger from the tap, and you see the light is at once entirely extinguished. We will try the same experiment with a gas jet. I bring the barrel of gas to the jet, and when I remove my finger the flame is at once blown out. The fact is, the gas is pouring out from this tap with considerable force, as is proved by its action on the flame. Again, I collect some of the gas in a beaker, and wait until there is reason to believe that the vessel is full. Having now got sufficient gas for our purpose, I empty the beaker on to some lime-water, and on shaking up the lime-water you see that a quantity of chalk is formed.

So much, then, for these illustrations of the way in which this heavy gas may be got from a vessel by all the ordinary processes that are employed for getting water out of a vessel. I refill our large jar for another purpose. You will remember that at a former lecture we had a cylinder apparently full of only one liquid—water—though in reality it contained two; the lower liquid was water, and the upper one was spirit, floating upon the water. * You may perhaps recollect the means by which we ascertained the line of demarcation between the two fluids. We dropped in a piece of wax, which sank through the spirit; but when it came to the surface of the water, it immediately floated upon it, showing the height to which the water reached. Now I can show you a somewhat similar experiment with this gas in this large jar, and you will see to what height the carbonic gas reaches. Instead of taking a piece of wax as I did when we were experimenting with the water and spirit, I will take a balloon—one of those toys with which we are all familiar. You see this balloon will not fall very quickly through the air, but still it would fall down to the ground in a moment or two if we allowed it. [A small india-rubber balloon distended with air was placed within a large cylinder, partially filled with carbonic gas. The balloon sank a short distance down the cylinder, and there floated on the surface of the invisible carbonic gas, indicating the height of the gas in the cylinder.] You see very clearly that the balloon floats on the surface of the carbonic gas just as the piece of wax did on the surface of the water. If I knock the balloon down through the carbonic gas, it will not keep down, but rises to the surface of the gas. I will try one more experiment* illustrative of the weight of this gas, to bring these experiments to a conclusion. I will now put into the jar another balloon, heavier than the former. It will gradually sink, and thereby indicate to us the pouring out of the gas. You will see from the fact of the balloon sinking lower and lower, that the jar is getting more and more empty. The gas from this jar is gradually pouring out into the cylinder below, and this we can prove by inserting a lighted taper into the lower vessel. The taper goes out.

LECTURE V.

GRAPHITE—DIAMOND—CARBONIC SULPHIDE.

Solution of charcoal in strongly heated iron, to form easily fusible mass of cast-iron—Separation, from slowly cooled cast-iron, of crystalline scales of graphite—Occurrence of graphite in nature as plumbago, or black-lead—Identity of graphite with charcoal, shown by formation of carbonic gas as the sole product of its burning—Its difficult combustibility in air, but ready combustibility in oxygen gas—Distinct chemical compounds of graphite—Production of graphite by strong ignition of the diamond—High relative weight and conductive resistance of diamond—Identity of diamond with graphite and charcoal, shown by formation of carbonic gas as the sole product of its burning—Combustion of diamond in oxygen gas—Liquefaction of carbonic gas by great pressure—Rapid vaporisation of liquefied carbonic gas, with great absorption of heat—Consequent freezing or solidification of residuary liquid—Slow vaporisation of solidified carbonic gas—Rapid vaporisation of solidified carbonic gas when wetted with ether—Great absorption of heat by the vaporisation, and consequent production of intense cold, sufficient to freeze mercury.

In this lecture I have to bring before you some very important points in reference to carbon or charcoal. You will remember that carbonic gas is oxidised charcoal,—a com-

pound of charcoal or carbon with oxygen. I want now to call your attention to some other compounds of this charcoal or carbon, and one of the most important is that which it forms with iron. If we take a piece of fine iron, such as is used for wire, we shall find that it is either free from carbon, or contains a very minute proportion—not more than one-tenth per cent. How do we know this? We know it because, when wire is burned, it scarcely yields any carbonic gas as a product of its burning, and therefore we conclude that the iron is almost free from carbon; but if we take the same iron and heat it strongly in contact with charcoal, we find, afterwards, that it has undergone a considerable change. It alters very much in its character; it no longer possesses anything like the toughness it formerly had; it is either very soft or very brittle, according to circumstances, but it has lost the toughness which characterised the piece of pure iron. It has, moreover, acquired this property, namely, that when it is burnt, either in air or in oxygen, it yields a very considerable amount of oxidised carbon, or oxide of carbon, or carbonic gas. It has taken up a considerable quantity of charcoal—a quantity which may occasionally amount to 5 or 6 per cent. It is often, however, 4 per cent. of the iron, and we know that it has absorbed this carbon by the alteration in its properties, and more especially by the fact that, when burned, it yields burnt carbon as a product of combustion. Well, this substance which is so produced, differs very remarkably in another way from pure iron—it is readily fusible, whereas pure iron is very difficult indeed to melt, and requires special arrangements for its fusion. We find that this substance, which is obtained by causing wrought-iron to enter into combination with carbon or charcoal, is a tolerably fusible material, so that it may be used for taking the finest castings. It is no longer pure iron, but a chemical compound of iron and charcoal. Now, when this compound is allowed to melt and cool slowly, it presents a very curious appearance, being covered with a series of scales. Here is a sample lent me by Mr. Abel, and here is another still more remarkable in its character. When we pick out these scales and examine them, we find that they consist of nothing but carbon; and we ascertain this by the fact, that when burned, they only yield carbonic gas or burnt carbon; so that the carbon which at first went into the iron is separated from it in the form of these scales, and we find that these scales are identical with black-lead or plumbago; in other words, we have converted this ordinary carbon into a substance known as graphite, black-lead, or plumbago.

Now, for some of the properties of this black-lead. It is a crystalline substance, and consists of pure carbon; it yields nothing but carbonic gas upon being burned; it is met with in nature, being found in metalliferous rocks, in Cumberland more particularly, and it is also found in meteorites. Here is a very fine section of a meteorite; it is a piece of iron that has fallen to the surface of the earth—it has fallen at any rate from the skies, and how much further we will not speculate. When we cut a meteorite in halves and get a section of it, we find that a great part of it is composed of iron; but in addition to the iron, we can pick out pieces of this black-lead, or graphite, or plumbago, such as we can manufacture artificially, in the form of scales, from the compound of charcoal and iron. Here is a piece which has been extracted from a natural mineral. Now this graphite, when burned, yields carbonic gas, which has the property of converting lime-water into chalk and water. If you look at my notes or syllabus of the lecture, you will find written, with regard to this graphite, "Its difficult combustibility in air, but ready combustibility in oxygen gas." Well, that is rather an understatement of the question; it is so little combustible that, for practical purposes, it may be considered incombustible. I have mentioned its "ready combustibility in oxygen," but even in oxygen graphite burns with very considerable difficulty, and some contrivances must be adopted to enable it to burn fairly. For this purpose I will take a specimen of this powdered plumbago, black-lead, or graphite, and introduce it into a tube,

formed of a piece of platinum foil. I put a small quantity of the graphite into the tube, and now I will light it by means of a piece of ordinary charcoal or pastille. Having ignited the charcoal, I will allow a current of oxygen gas to pass on it, and when once the graphite takes fire, you will observe, I think, that it will burn with very considerable brilliancy. The graphite has now ignited, and you see the very brilliant manner in which it burns. It is, then, capable of being burned in this way in a current of oxygen, and, in burning, it produces nothing but this carbonic gas, or oxidised carbon as its product of combustion, proving that it consists of nothing else but, and is identical with, carbon. Now, this substance, graphite—this form of carbon—has been examined very carefully by Sir Benjamin Brodie, who has found that it has some very curious properties, and to some of these I will direct your attention. If we take charcoal, and act upon it by chlorate of potash and oil of vitriol, the effect is such that it is impossible by the eye to distinguish the product from ordinary graphite; but it differs from graphite in the effect of heat on it. You will see the black substance which we have at the bottom of the test tube covering it to the depth of half an inch or so; upon this I will now try the effect of heat. The action is already taking place, and you observe that the mass is beginning to grow. It is giving off steam, and now this substance, which has been partly acted upon by the acid, and become partly oxidised, has swollen up to such an extent as to occupy fully two-thirds of the tube, and I have no doubt that, by continuing the heat a little longer, I may be able to push the substance up to the very extremity of the tube. It is still moving upwards, and getting nearer and nearer to my fingers every instant. The tube is now very nearly full; in another moment I shall not be able to hold it,—it will become so hot; and now you see that this black-lead, which formerly occupied a very small part of the tube, has swollen up and filled it.

Well, what is the nature of this change? It was only ordinary black-lead. We acted upon it by the mixture; I applied heat to it, and thereby converted it into the original black-lead with which we started. Now Sir Benjamin Brodie has submitted some of this graphite to the action of very strongly oxidising agents, and has so converted it into a yellowish crystalline substance, which he calls *graphic acid*. I heat some of this graphic acid, which has kindly been supplied for this occasion by Sir Benjamin Brodie, and you will see that its behaviour is still more curious than that of the graphite with which I operated a minute ago. I take even a smaller quantity of this graphic acid than we did of the graphite. I apply heat to the flask containing the substance; you see, from the sparks, the combustion that is taking place inside the flask, and you also see the large amount of soot that is being generated. [A pause.]—The action is now over, and you will observe that our flask is completely full of soot. In this way, I have converted our graphite back into ordinary charcoal, of which I have here sufficient to fill the tube entirely.

I have told you one or two ways in which graphite may be made, and now I will show you another. You are all familiar with the diamond. Mr. Tennant has lent me a collection of diamonds which are in the tray before you. I am afraid they will not prove as interesting to the ladies as if they were mounted in a different fashion, but they are mounted in this way to display their various colours. Of course, the finest diamonds are colourless. You will see the beautiful manner in which these stones glisten now I illuminate them by the magnesium light; and if you take the trouble to examine them after the lecture, you will see that they are well worthy of examination, because they are not cut simply in the ordinary form, but so as to show that they present nearly all the colours which diamonds possess. Now, the diamond has this property—that it will stand a red heat. You may make it red hot, and it will be none the worse for it, but there is a degree of heat which it will

not stand. The degree of heat, capable of being produced by the electric arc, alters the diamond; and into what does it alter it? Into a mass of graphite or plumbago. We come, then, to this conclusion,—that as diamond is the same thing as plumbago, and as plumbago in its composition is nothing more than ordinary charcoal, therefore diamond itself is only charcoal; and we can ascertain this fact in another way, for when a diamond is burnt in charcoal it yields this carbonic gas. I now want to show you the result of its combustion. Here we have a jar of oxygen gas, here we have a diamond, and here is an arrangement for making the diamond red-hot by means of a galvanic current. I introduce the diamond into our globe of oxygen, and while there I will make it red hot. When it has once become hot, it will burn in the globe for an instant or two. I am now making our diamond red hot; it takes some little time to bring it to the proper heat; but as soon as this is attained, it will begin to burn. The burning of the diamond in oxygen is attended by the formation of carbonic gas, the presence of which is indicated by the ordinary lime-water test.

There is one further remark I wish to make to you relative to the diamond. It differs from plumbago in appearance, and also in specific gravity, for it is a very heavy substance. An ordinary piece of plumbago is about two and a quarter times as heavy as water. Charcoal is from one and a half to twice the weight of water, but the diamond is three and a half times as heavy, and hence is a very much heavier substance than ordinary charcoal, or even than plumbago; and so, again, with regard to electricity. There are some bodies through which the electric current will pass freely; through others it does not pass, as they are capable of resisting the current. Now, a diamond resists the current, whereas charcoal does not; thus a diamond differs from charcoal in this as well as in many other very important particulars.

I will now call your attention to a remaining property of carbonic gas, which is that, when it is compressed, it is capable of being actually brought into the liquid state. That iron vessel before you is at present filled with what was carbonic gas. It is so no longer; it is liquefied, and might be called *carbonic liquid*. It is like water in appearance, and consists of nothing but carbonic gas compressed into a liquid condition. This liquid is a very curious substance, and when, by removing the pressure, we allow it to escape into the gaseous state, it becomes intensely cold. Why it thus becomes cold I cannot stay to tell you, but when this reduction of temperature takes place, the substance is partly converted into the solid state. When converted into the gaseous state, or into carbonic gas, the liquid becomes so cold, and absorbs so much heat, that the remainder is converted, as I have said, into the solid state. I am now going to collect some of this solid substance in a box. I warn you that upon opening the cylinder there will be a little noise, but you must not be startled by it. Before putting the box upon the cylinder, we will allow some of the carbonic gas to escape, and you will see it solidifying in the air. [Some of the compressed gas was then allowed to rush out of the cylinder, and on doing so it formed a white snow-like shower of solid carbonic acid.] You see we thus get a large quantity of this carbonic snow.

I will now try to collect some of this solid matter in a box. [Some of the compressed gas was allowed to escape into a brass box, and there became solidified.] Our box is now full of the solidified gas, which I will empty out. That you may see how cold it is, I will place a piece of ordinary wet flannel round the box. You see that when I do so, the flannel is at once frozen so firmly to the box, that I can support its weight by means of the strip of frozen flannel. I will now take a portion of this solid gas and put it into a retort, and then you will see its gradual conversion into the gaseous state, and I shall be able to collect some of the gas over water. After putting the substance into the retort, I close it with a stopper, and that which was carbonic solid is gradu-

ally, as you see, converted into carbonic gas, and that gas is being collected over water. I will now give you another illustration of the property of this substance. Although it is so very cold, yet when I place a piece of it upon my hand, I do not feel it to be so; I can keep it there for a considerable time. The solid itself does not touch my hand, for it is separated by some of the carbonic gas into which it is becoming resolved, and hence it does not seem very cold to me, although it very readily froze the piece of flannel. If I let some of this substance come into contact with water, you will see its curious action; I will allow a piece to float on water, and you see it is gradually and very slowly evaporating. It does not freeze the water, although it froze the flannel in an instant. Here is another illustration of this property. If I take a common soda-water bottle, and fill it with ordinary water, I convert this ordinary water into soda-water, by adding to it some of this solidified carbonic gas. I will take a few pieces and drop them into a bottle of water. I then cork the bottle and shake it up for a minute or two, and we shall find that the carbonic gas so produced, dissolves in the water, and converts what was a bottle of ordinary water into a bottle of soda-water. [After a short interval]—The solid carbonic gas which I put into the bottle of water has slowly dissolved, and I know that the experiment has succeeded, because it is as much as I can do to hold the cork in the bottle. You see, when I remove my hand, that the cork flies out, and that we have obtained a bottle of soda-water which effervesces in the usual manner.

I will give you another illustration of the freezing properties of this solid carbonic gas. I here take a stool, and upon it I pour a little water. I then place upon the wet stool a glass beaker, into which I put some of the solidified gas. The evaporation from the substance contained in the glass is so rapid, that in an instant or two we shall succeed, I have no doubt, in freezing the beaker to the wet stool. [The freezing took place almost instantaneously, and, in order to demonstrate the firmness of the adhesion, the lecturer lifted the stool by means of the glass beaker which was frozen to it.] You see the vessel is frozen to the stool with very considerable force, and a good deal of strength would be required to detach it.

I will now endeavour to freeze a quantity of mercury with a further portion of this solidified matter. [Some mercury was frozen by being brought into contact with the solid carbonic acid.] I have now frozen our mercury sufficiently for you to see the character of this freezing action. I hold the mercury by a wire, and, in this way, I can lift it. I will suspend the mass of mercury in water, where it will melt, and when it melts, you will see it pouring down through tubes of ice. Now when you consider that the temperature required to freeze mercury is exceedingly low—forty degrees below the freezing point of water—you will be able to form an idea of the great degree of cold which we can attain by the use of this solidified gas.

We have sufficient material left for a final experiment. I will put some of the solidified gas into a red-hot crucible, add a little ether, and then some mercury, and even then the mercury will be frozen. [The experiment was performed with a successful result.] We have succeeded in actually freezing mercury in a red-hot vessel. Here we have brought the mercury to a solid mass. I will now put it into some water, and it at once begins to liquefy, and as it liquefies it freezes the water, and forms little hollow tubes of ice, through which it falls to the bottom.

LECTURE VI.

CARBONIC DISULPHIDE—CARBON—CARBONOUS OXIDE— CARBONIC GAS.

Burning of charcoal in sulphur vapour, to form carbonic disulphide; ready changes of carbonic disulphide from gaseous to liquid, and from liquid to gaseous state, by alterations of pressure—Absorption of heat, or production of cold, by vaporisation of liquid carbonic disulphide—Analogies of gaseous carbonic disulphide and carbonic

gas—Great weight and ready inflammability of carbonic disulphide vapour—Its brilliant combustion in current of oxygen and when mixed with nitric oxide gas—Liquid carbonic disulphide heavier than, and immiscible with, water—Its dissolution of iodine, with assumption of deep purple colour—Unburnt carbon, or charcoal, the characteristic constituent of vegetable tissue—Ready burning of charcoal and wood in air or oxygen, with production of carbonic gas—Destiny of unburnt charcoal to become oxidised or burnt at some time or other—Carbon burnt into carbonic gas in processes of respiration and decay—Partial unburning, or deoxidation, of carbonic gas into carbonous oxide by ignited iron—The reburning or re-oxidation, of carbonous oxide into carbonic gas attended by a great development of heat—Unburning of carbonic gas into carbon by ignited sodium—Partial unburning of carbonic gas into carbonous oxide and oxygen, effected by heat of the electric spark and of the oxyhydrogen blowpipe—Reburning of separated carbonous oxide and oxygen into carbonic gas—Disappearance or absorption of heat in the unburning, and re-appearance or evolution of heat in the reburning—Complete unburning of carbonic gas into carbon and oxygen in growing plants exposed to light and heat of the sun—Oxygen of unburnt carbonic gas discharged by growing plants into the air—Carbon of unburnt carbonic gas transformed by growing plants into woody fibre, starch, sugar, &c.—Disappearance or absorption of the sun's heat in the unburning of carbonic gas effected by growing plants—Re-appearance or evolution of the sun's heat in the reburning of wood and charcoal into carbonic gas.

You will remember that when a diamond is made exceedingly hot, it is converted into a mass of graphite, or plumbago, or black-lead, these three terms meaning the same thing. Now as black-lead, or plumbago, or graphite, is nothing more than charcoal, and as diamond can be converted into black-lead, it follows that diamond is in reality charcoal. But we know this in another way; when we burn a diamond, we find that the only substance it yields is burnt or oxidised carbon—in other words, carbonic gas. I will now show you once more the burning of the diamond. In this globe of oxygen gas is a diamond, surrounded by a piece of platinum wire; this wire I will make red hot, and it will communicate its red heat to the diamond. As soon as the diamond is thus made red-hot, it will burn in the oxygen gas. [The experiment was performed as described.] The diamond has now begun to burn. You see its brilliant glow in the globe of oxygen, as it is being slowly consumed. I take away the platinum wire, but the diamond continues hot quite independently of it, and gives a bright spot of light, which is due to its strong ignition and to the fact that it is actually burning. The diamond is being converted into burnt or oxidised diamond, or into burnt or oxidised charcoal; and we may test this in an instant by introducing a little lime-water, which we thus convert into a mixture of chalk and water, chalk being the compound formed by the combination of burnt carbon, or burnt diamond, with lime. I shake up a little lime-water in the globe, and though, for obvious reasons, I have not burned a very large diamond, yet I have obtained this carbonic gas, or oxide of carbon, or burnt carbon, by means of which I have converted our lime-water into a mixture of chalk and water. This effect, I think, is visible all over the theatre.

We have now considered a great many of the changes of carbon or charcoal. We have considered the change of charcoal into black-lead, the change of diamond into black-lead, and the change from black-lead back again into charcoal; also the change of charcoal, of black-lead, and of diamond, into burnt charcoal of carbonic gas. We have likewise considered indirectly the conversion of certain compounds of carbon and hydrogen into carbon, in the imperfect combustion of coals, candles, and similar substances.

I want now to call your attention to some other changes which charcoal is capable of manifesting, amongst which is the change it undergoes in its combination with this substance—sulphur or brimstone.

We usually see sulphur as a solid substance—in the form of sticks or rolls; it is somewhat brittle, but is very easily brought into a liquid state. If we heat it, it melts like a piece of ice, and yields liquid sulphur, just as the melting of a piece of ice yields water. If we heat the sulphur still further, it will boil just like water, and in that way we obtain sulphur gas, which is a vapour of a deep orange colour. Here is some sulphur which is at present liquefied; in a

minute or two it will boil, and then the flask containing it will be full of the vapour of sulphur, which you will recognise by its deep orange colour. Just now the vapour is scarcely visible, for the sulphur does not yet fairly boil; it is now beginning to do so, and soon you will see the flask filled with a deep orange-coloured and perfectly transparent gas or vapour. This gas or vapour is characterised by its considerable weight, by its dark orange colour, and by the facility with which it is changed back into the liquid state; wherein it differs from oxygen gas, although in some respects it corresponds very closely with it. You will remember that not only do ordinary combustible substances, such as coals or candles, burn in oxygen gas, but certain metals also. I showed you the combustion in oxygen of zinc and of iron; I will now show you the burning of some metals in this vapour of sulphur, and you will see that they burn in it very much the same as in oxygen. I take a piece of copper, and first warm it a little; I then introduce it into the sulphur vapour, and you see that it burns very completely, just as our piece of iron did in oxygen. You see that when I introduce the piece of copper into the sulphur vapour, the copper becomes brilliantly hot, and gradually consumes in the interior of the flask, which gets filled with this deep-coloured vapour. In this particular, sulphur vapour corresponds very closely with oxygen. Now, will a piece of charcoal burn in this deep orange-coloured sulphur-gas or vapour, which is now quite visible? I light a piece of charcoal: if I put it into a globe of oxygen it would burst into a flame; but when I put it into sulphur vapour it is immediately extinguished—it will not burn in sulphur. Nevertheless, it can be made to enter into combination with it; that is to say, if, instead of trusting for the necessary amount of heat to the burning of the charcoal in the sulphur vapour, we heat the charcoal strongly, and keep it strongly heated whilst in the sulphur, then the carbon and the sulphur will enter into combination one with another. When iron and oxygen burn, we get oxide of iron; sulphur and copper burnt together yield disulphide of copper, just as by combining copper with oxygen we obtain oxide of copper. Now, if we introduce the heated charcoal into sulphur vapour, and burn it there by keeping it hot, we get disulphide of carbon.

What is the nature of this disulphide of carbon? In the first place, ordinarily a liquid. Here we have some specimens of it. You will remember that the carbonic gas can be liquefied, and I showed it to you in that state; in the same manner we can gasify disulphide of carbon. This tube, which looks as if it were empty, contains some of the gas of disulphide of carbon. This gas is very easily reduced into a liquid state; if I allow the ordinary weight of the atmosphere to press upon it, the mercury will rush up the tube, and some of the vapour will be converted into liquid. By putting on a little pressure from my mouth, I can convert the whole of this gas into liquid. [The pressure of the atmosphere was allowed to operate on the contents of the tube.] You see the mercury already begins to rise, showing that we have converted a considerable quantity of our disulphide of carbon gas into disulphide of carbon liquid. By blowing into the tube with a little force, I shall be able to push the mercury up to the top of the tube, and by that additional pressure the whole of the disulphide of carbon gas will be converted into a liquid, just as by means of an iron vessel I was able at the last lecture to pump a great quantity of carbonic gas into the interior of the vessel, and so obtain it in a liquid condition. You will notice that when, through my blowing, the mercury reaches the top of the tube, it will strike it with a slight noise, which many of you will be able to hear. This disulphide of carbon, then, we may regard as a substance which is sometimes in the liquid state, with a strong tendency to become a gas or vapour, and sometimes in the gaseous state, with a strong tendency to become a liquid.

Now for some of the properties of this compound when in the liquid state. I ought to warn you that disulphide of carbon, whether a liquid or a gas, is characterised by a some-

what disagreeable odour. Perhaps on this account I ought not to bring it before you, but it has properties so remarkable in many respects that I cannot refrain from introducing it. First with regard to its weight. It is very much heavier than water; to show you how heavy it is I will pour some of it into this water. In these experiments I usually colour the water blue or red, to render it visible to you, but in this instance I have coloured it brown by using iodine, for reasons which you will presently understand. I pour some of this disulphide of carbon through the brown water, and you see it at once falls to the bottom; and something else also happens. The liquid poured into the brown water was colourless, but now that it has fallen to the bottom through this brown liquid it has become decidedly pink in colour; but there is something more. I shake the two liquids up together, and you will find, I think, that the disulphide of carbon will take away all the brown colour, and instead of itself becoming brown it will become pink. It is a very curious circumstance with regard to this iodine, that it dissolves in some liquids, forming a brown liquid, but that on dissolving in disulphide of carbon it forms a deep pink. The disulphide of carbon has fallen to the bottom and assumed its beautiful crimson colour, and I think we shall find that by the time it has quite settled we shall have two distinct layers of liquid, and the upper one will be colourless. You will observe how colourless the supernatant water will eventually become. Disulphide of carbon is heavier than water, in the proportion of about thirteen hundred to a thousand; that is to say, if were to take a volume of water which weighed a thousand grains or a thousand pounds, and the same volume of this disulphide of carbon, we should find the disulphide of carbon weighed thirteen hundred grains or pounds. But, although this substance is heavier than water, it is not so heavy as a saturated solution of salt. [This fact was illustrated by a small quantity of a saturated solution of salt being placed at the bottom of a vessel of disulphide of carbon, and there remaining.]

Now for another property of this disulphide of carbon. It consists of sulphur or brimstone, and charcoal, and both brimstone and charcoal are very combustible or easily burning bodies; and the fact that the brimstone and the charcoal are in combination instead of being separate, does not at all interfere with their combustibility. Accordingly, if I moisten a sponge with a little disulphide of carbon, and bring it to the flame, you see that it at once burns with a lambent blue flame. There are two or three very interesting points connected with the combustion of this substance. When it burns, and there is sufficient air, the charcoal is converted into oxidised or burnt charcoal, in the form of carbonic gas, and the sulphur into oxidised sulphur or sulphurous gas. But if there is not sufficient air what will happen? The charcoal only will be burnt. You will remember that when we took an ordinary candle, or a gas flame, and cut off the supply of air, the hydrogen only was burnt and not the charcoal. In the present case when the supply of air is insufficient for perfect combustion, the charcoal burns and the sulphur does not. That is one interesting point connected with the burning of disulphide of carbon. The other is, that it is one of those substances which are ignited with the greatest ease. I have here an ordinary test tube containing a little olive oil. I heat this up to a temperature a long way short of red heat—a temperature which corresponds to about four hundred degrees Fahrenheit, or about twice as high as that of boiling water. The tube of oil being sufficiently hot, I will place it in the disulphide of carbon vapour, and I want to show you that with that tube of hot olive oil I shall be able to set fire to the disulphide of carbon. I will pour a little of the substance into these glasses, and then try to ignite it, not by a match or a lighted taper, but simply by this tube of heated oil. [Disulphide of carbon vapour was inflamed by the tube of hot oil.] You see that we can readily set fire to this substance by means of a little heated oil. It is, in fact, one of the most easily combustible of all the common substances known to chemists. It gives off vapour, or becomes vapour-

ised, very easily and very quickly, and, moreover, the gas or vapour of the disulphide of carbon is very heavy. It is much heavier than carbonic gas, which I showed you in a previous lecture, for whereas carbonic gas is only about one and a half times as heavy as air, this is two and a half times as heavy. I will give you an illustration of these two points together—the great facility with which this substance is converted into vapour and the heaviness of its vapour; and then, thirdly, I will illustrate to you its inflammability. I have here a piece of sponge moistened with the disulphide; I put it at one end into the corner of this long flat box, and under these circumstances it will give off vapour. I want to see at what distance I can light the vapour which is given off from the moistened sponge. The vapour will doubtless fill the box, and I shall be able to ignite it from the extreme end or corner of the box. I approach the flame carefully with the light, and when the vapour is lighted, it shrinks at once to the other end. You see that it is very easy to ignite, and difficult to extinguish. I will now give you some further illustrations of the heaviness of this disulphide of carbon. Here I have a bottle apparently empty, but really containing disulphide of carbon gas. I will pour a little of this heavy gas into this tall jar, just as the other day I poured the carbonic gas. I take our apparently empty bottle, and having poured the gas from it into the jar, I apply a light and ignite the gas. Now we will see whether we cannot go a little farther. We have now two glasses; I take the bottle containing the disulphide of carbon vapour, and fill this first glass with it. I now pour some of the gas from the first into the second glass, into which I put a light, and you see the gas takes fire. I will repeat the experiment, using three smaller glasses instead of the two larger ones. I take the bottle of gas, and begin by filling this first glass; I transfer a portion of the contents of the first glass into the second, and next I pour a portion of the gas from the second glass into the third. Now we will see whether all these three glasses contain this inflammable gas. [A lighted taper was applied successively to the third, second, and first glasses, and in each instance the presence of the disulphide vapour was manifested by its ignition on contact with the flame.] We might go on in this way; indeed, I have extended the experiment to as many as four or five glasses. Now I have here a glass barrel, which is apparently empty, but really containing this disulphide of carbon vapour, and so heavy is the vapour that I shall be able to draw it out from the tap of the vessel. I hold a beaker under the tap, and so draw into it a little of the vapour. Our beaker being sufficiently full for our purpose, I turn off the tap, and on bringing a light near the beaker, the gas in it takes fire. I will give you one more illustration of the weight of this disulphide of carbon. You know it is a very common practice to draw off liquids by means of a syphon, and I will try whether this can be done in the case of this vapour. I insert one end of the syphon in the vessel of vapour, and fill the syphon in the ordinary way by sucking it. Our syphon is now full, and the gas issues from the end of it. I hold these vessels under the syphon in order to receive the gas which is flowing from the end of it, and you see that I can thus catch the gas, and then I shall be able to set it on fire.

I have given you several illustrations of the facility with which this substance is converted into vapour, and also of the inflammability of the vapour. I want now to show you that if I vapourise it more rapidly, which may be done in a current of air, I can produce a great amount of cold. In my last lecture I showed you the amount of cold that could be produced by the vapourisation of the liquefied carbonic gas. Now I want to show you the amount of cold that can be produced by the vapourisation or gasification of liquid carbonic disulphide. I pour some water on the top of this stool, and then place the beaker on the wet part. I next pour some disulphide of carbon into the beaker, and blow a current of air upon it. By this means our disulphide of carbon is very quickly converted into vapour. It is now rapidly va-

pouring, at the same time producing a very intense cold, and I have no doubt that in a minute or two this beaker will have become so firmly frozen to the stool that I shall be able to hold up the latter by means of the beaker, just as I did the other day when illustrating the cold produced by the spontaneous vapourisation or gasification of the solidified carbonic gas. You will remember that in that case I allowed the vapourisation to take place spontaneously. In the present instance I cause the vapourisation by a current of air which is being blown upon the liquid from below. [After a short interval the glass beaker was found to be frozen to the top of the stool.] It is now frozen, but I will allow it to remain a little longer so as to make sure that it is frozen sufficiently firmly to allow me to hold up the stool by the glass. [After a short pause]—Here you see I am lifting up the stool by the beaker; the two adhere so closely that it requires some considerable force to separate them.

In the experiment just performed I vapourised some disulphide of carbon simply by blowing air upon it; but now I am going to boil it, and I want to show you what a beautiful and extensive flame may in this way be produced. It is a liquid which both boils and vapourises very quickly. It is beginning to boil, and you see the beautiful lambent flame with which it burns. I now turn on a supply of oxygen, and in this I burn the disulphide vapour. I want you for an instant to form an idea of the length of this brilliant and peculiar blue flame; but I must not let it burn long, because it produces a great deal of sulphurous gas, which is very unpleasant.

The last property of this disulphide of carbon to which I wish to call your attention is the mode in which it burns, not in oxygen or in air, but in another gas which I have not hitherto considered in my lectures on carbon, namely, an oxide of nitrogen, and I will show you the very brilliant manner in which the disulphide of carbon will burn in it. Here we have a cylinder of the gas, and here, in this small glass globe, is our disulphide of carbon. I let the disulphide of carbon globe fall to the bottom of the jar, and, of course, in doing so it breaks, as you see, and I shake it up with the other gas. [The mixture was then ignited, and produced a very brilliant flash of light.] This is the last experiment that I have to show you with this liquid or vapour, which, although very interesting, is very disagreeable in many respects.

And now we pass on to the consideration of an entirely different section of our subject. You will remember that ordinary charcoal is obtained from wood. When wood is strongly heated or burnt in a limited supply of air, the carbon of the wood scarcely burns at all, and we have this carbon preserved to us in the form of charcoal. Charcoal, then, is the chief constituent of wood, in which substance it exists in the unburnt condition; and not only does charcoal exist in wood, but in nearly all vegetable substances. The seeds of wheat contain starch, in which charcoal exists; sugar, too, contains a considerable proportion of charcoal, and when these substances are burnt they leave a great deal of charcoal behind. Here, for instance, we have some wood shavings. Now I can very readily show you the charcoal in these wood shavings by pouring upon them a little of that very corrosive substance called oil of vitriol. By letting this liquid act upon the shavings for a little time they quickly change into a mass of black charcoal. In the case of such a substance as sugar, the action takes place still more rapidly. Here in this large cylinder are some pieces of sugar; I moisten them with a little hot water, and then pour some oil of vitriol upon them, and you observe that when I do so the sugar is at once converted into a mass of black charcoal. [The sugar became rapidly charred by the sulphuric acid, and the admixture emitted steam, and swelled into a black spongy mass, overflowing the glass jar in which the experiment was performed, and which, in the first instance, was not more than one-third full.]

All these substances which I have mentioned to you as containing carbon, burn very readily into burnt carbon or

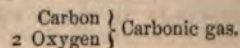
carbonic gas. If, for instance, I burn a piece of wood in a small tube of oxygen, you will find that a brilliant flame is produced, and the result will be the formation of carbonic gas, which is proved by the application of the lime-water test.

Instead of burning the charcoal directly in oxygen gas, as I have done in two or three previous experiments, I am now going to burn it in a substance which contains oxygen gas; and it shall be burnt under water and the carbonic gas which is produced collected in a cylinder. [A mixture of nitre and carbonaceous matter was burnt in a tube under water.] You see that, in this way, our cylinder which was full of water is now becoming full of burnt charcoal or carbonic gas. I cause some of the gas to bubble up through lime-water, and you see the lime-water becomes converted into a mixture of chalk and water, proving that we really have produced gas of this kind. I will now collect some of the gas in a separate vessel, and again show you its nature by its property of extinguishing flame.

Now, if you reflect a little, I think you will come to this conclusion,—that substances which grow, vegetable substances, are all of them destined ultimately to become burnt, or to undergo a change equivalent to burning. A great deal of wood, for instance, is chopped up and used for fire wood; a great deal more is used for building ships, for forming the interior portions of houses, and making furniture. These ships and houses and furniture last for a certain time; they gradually pass from an honourable into a dishonourable condition; old furniture is put into the lumber room; the disabled ships are broken up and destroyed, and at last they go to the fire, where the carbon becomes oxidised or converted into carbonic gas. But there is a great deal of vegetable matter which never undergoes this burning. In the autumn a large quantity of leaves fall to the earth and there undergo some sort of change; this change is, in fact, a very slow burning, but without the phenomena of ignition which we see in the case of a fire, although the leaves are converted into carbonic gas or oxidised carbon. Now here is a bottle which contains some decaying wood, and, as I showed you in the last lecture, a lighted taper introduced into the bottle is at once extinguished by the burnt carbon or carbonic gas, which has been produced by the oxidation of the wood in the process of decay. Here, again, is some rotting sawdust; this also gives rise to carbonic gas, which extinguishes a lighted taper introduced into it. You see, therefore, that although the wood does not actually undergo the process of burning, as we are accustomed to see it, it does undergo the process of decay, which is a conversion of the original carbon into burnt charcoal. But a great quantity of vegetable substance neither undergoes burning nor decaying, but is eaten. We know that cattle feed largely on corn and straw, and we ourselves consume much wheat and other grain. In these instances, although the vegetable substances do not, strictly speaking, decay, yet they undergo another form of the process of oxidation, by which burnt charcoal is produced. For example, if we take a little lime-water, and blow, or rather breathe, through it, we have evidence of a considerable amount of burnt carbon being present in the breath. In this case, the carbon, instead of having been burnt in a furnace, has simply been burnt in our bodies, thereby rendering our bodies warm, just as when it is burnt in the fire it warms a room. In order to show you the presence of carbonic gas in the breath, it will be quite sufficient for me to breathe into a bottle of lime-water. Here is one—I breathe into it, close it, and shake it up, and by that simple act I have, as you see, produced a very considerable quantity of chalk, showing the presence of carbonic gas, or burnt carbon.

All vegetable tissue, then, comes sooner or later to be burnt, or oxidised, or converted into carbonic gas.

The next point which I should like you to notice is the unburning of carbonic gas. How is it possible to do this? On this subject I must just call your attention to what is here written upon the diagram:—



Carbon }
1 Oxygen } Carbonous oxide.

Carbonic gas is really a combination of one proportion of carbon and two proportions of oxygen. Now there is another oxide of carbon of which I have not yet spoken, which consists of one proportion of carbon and one of oxygen: it is called carbonous oxide. If I take carbonic gas and half unburn it, I remove one-half of the oxygen, and the result is carbonous oxide. How is this done? Well, one way is by burning something in carbonic gas. If you take one of the few substances that will burn or oxidise in carbonic gas, you will find that that substance by its burning will take away some of the oxygen from the carbonic gas, and thereby convert it into carbonous oxide. One of the commonest forms of this experiment is to take some carbonic gas and pass it through a tube filled with red-hot iron. Under these circumstances, the iron takes away some of the oxygen, or unburns the carbonic gas down to carbonous oxide; but I am about to show you a more convenient form of the experiment, and one for which I am indebted to Dr. Taylor.

I take, not metallic iron, but metallic magnesium, and I will show you that, although a taper is extinguished in the carbonic gas, yet the magnesium will burn. I introduce a piece of ignited magnesium, and it continues to burn in the carbonic gas. You see that a taper, when introduced into the same gas, is extinguished, whilst the light of the magnesium, under the same circumstances, is so brilliant that it almost blinds one for the moment. Now when this metal—magnesium—burns in this way it reduces, or decomposes, or unburns, the carbonic gas to the state of carbonous oxide; but there are some metals, you will remember, which go beyond that. When a piece of sodium is burnt in carbonic gas, it not only unburns the carbonic gas to the state of carbonous oxide, but it takes away all the oxygen and reduces the carbonic gas again to a piece of charcoal. By means of the magnesium, we unburn the gas by taking away one proportion of oxygen, and reducing it to a compound which contains one proportion of oxygen and one of carbon; but when sodium is used, the two proportions of oxygen are taken away and the carbon left free.

Here is a vessel generating carbonic gas in the usual way. The gas is being conducted into this glass globe, and it is there made extremely hot by the action of the electric spark. An intense degree of heat is produced, and, under these circumstances, the carbonic gas breaks up into a mixture of carbonous oxide and oxygen. Now for this purpose we do not necessarily require the heat of the electric spark. Even the heat that we can obtain by the combustion of a flame of ordinary gas in a current of oxygen is quite sufficient for our purpose. I have here a supply of coal gas; I pass oxygen into its flame, and with this flame I will heat a platinum coil. I now allow the carbonic gas to pass through the heated platinum coil, and in its passage the carbonic gas is decomposed into carbonous oxide and oxygen. To give you some idea of the amount of heat which can be produced in this way, I will hold in front of the blowpipe flame a plate of iron. You see that, although this plate is one of considerable thickness, it is utterly unable to withstand the high degree of heat which I am in this way applying to it. [Holes were burned in the plate of iron at those points on which the flame was allowed to impinge.]

When our carbonic gas is subjected to this extreme degree of heat, it undergoes decomposition—not into carbon and oxygen, but simply into carbonous oxide and oxygen. It only becomes one-half unburnt. Now are there any agencies in nature by which this carbonic gas can be completely unburnt? There is one, and one only, that is, through the influence of vegetation under exposure to the sun's rays. If, in the spring time, when the sun is shining, we take some rapidly growing plant—for instance, a sprig of mint, which answers the purpose very well—and immerse it in a vessel of water which is charged with carbonic gas, that carbonic gas will undergo an unburning; its oxygen will gradually bubble up from the leaves of the plant, and rise to the top

of the vessel of water; but what will become of the carbon? It will be converted into starch and wood and sugar and other substances, which go to form the living plant. By this means only can the carbonic gas be unburnt into carbon, which goes into the tissues of the plants, and into oxygen, which is given off again into the atmosphere.

Now what is the point of interest in an unburning of this kind? If I were to allow an electric spark to pass through the air it would give out a certain amount of heat, but, on passing through the carbonic gas, it emits a considerably less amount. Well, what has become of the difference? It has gone somewhere. If I take this mixture of carbonous oxide and oxygen, produced from the carbonic gas by the passage of the electric spark, and set fire to it, it gives out exactly the amount of heat that disappeared from the heat of the spark. In that case, the carbonous oxide and the carbon burn together. I will give you an illustration of the combustion of these two substances. Here is a large cylinder of the half unburned carbonic acid; I set fire to it, and you see the curious blue flame which it emits and the peculiar manner in which it burns. I have also some of the carbonous oxide burning from a tube, and if I hold over its flame an empty bottle, I shall be able to collect the burned carbonic gas which is so produced. You see the beautiful blue flame which the carbonous oxide sends out from the tube. I may also show you the considerable amount of heat which it gives out in burning. If I introduce into the flame a piece of platinum wire you see it immediately becomes very red, showing the flame to be exceedingly hot. Now when I burn together the carbonous oxide and the oxygen, which have been separated from one another, exactly the same amount of heat is given out by it that was absorbed from the electric spark by the products of the unburning of the carbonic gas, and was not used in heating the surrounding air.

Now, if the sun, instead of shining on the plants which grow on the earth's surface, were to shine entirely upon the stones, it would heat the atmosphere a great deal more than it does. As it is, a portion of the sun's heat disappears. What, then, becomes of it? It is absorbed by the vegetation. The amount of heat absorbed by a growing piece of wood in unburning the carbonic gas of the atmosphere into charcoal and oxygen, is exactly the amount which the piece of wood is capable of giving out when its carbon is returned in the air; and, accordingly, when we burn coals, or wood, or peat upon our fires, or consume bread, and oil, and wine in our bodies, and thereby produce a considerable amount of heat either in the fires or in our bodies, we are really manifesting once more, in the form of heat, the sun's rays, which years and years before shone upon the plants from which those substances were derived. We are getting back the sun's heat, which was originally absorbed by the growing plants. When we burn any one of these substances we recover from them the sun's heat which disappeared in their growth. We will here burn some sugar, and we shall be able to regain very easily an exhibition of the sun's rays that were absorbed in separating the carbon of the sugar from the oxygen with which it was in combination, and which, upon being separated, was discharged into the air. I pour a drop of this liquid upon the mixture of sugar, and you see the very brilliant evolution of the sun's rays which were bottled up in the formation of the sugar.

And now it only devolves upon me to thank you heartily for your kind attention during these lectures. I hope, that whenever again you see a piece of coke, or a piece of charcoal, or a piece of marble, or a growing plant, you will remember the curious relations of change which exist between them, and how the one is capable of being converted into the other.

FOREIGN SCIENCE.

PARIS, MARCH 3RD, 1869.

Action of Iodine on Sulphides.—Alloys of Copper and Tin.—Union of Free Nitrogen and Acetylene and Direct Synthesis of Hydrocyanic Acid.

M. M. FILHOL and MELLIER have published a research upon the action which iodine exerts upon various sulphides. The action which iodine exerts on alkaline sulphides is already known; it consists in the displacement of the sulphur by iodine; the manner in which iodine acts upon insoluble sulphides is, however, but imperfectly known. Both natural and artificial sulphides were operated upon, and iodine was brought in contact with these bodies, sometimes in a dry state, and at others in solution in alcohol, ether, sulphide of carbon, chloroform, &c. The action is generally rapid in the case of artificially prepared sulphides, in the form of precipitates; it is sometimes accompanied by great heat, reducing a portion of the iodine to vapour. For this reason, it would probably be dangerous to mix sulphides and iodine dry, or in any quantity. Natural sulphides are attacked more slowly, but the elevation of temperature is observable in certain cases. The same effect is produced when iodine in a solution of iodide of potassium is made to act upon the sulphide. In certain cases, the reaction is complicated by the presence of the solvent and the easy decomposition of the iodide.

In a note communicated to the Academy by M. Riche, the following facts concerning the alloys of copper and tin are given. The question of density is first taken. Some determinations were made upon bars of these metals, weighing from 50 to 60 grms., but the results obtained were unimportant, owing to the great difference which exists in these alloys. The same metals, reduced to fine powder, were afterwards operated upon, when it was observed that the contraction increases very regularly from the very rich alloy in tin to the mixture SnCu_2 , and from this point it increases suddenly, arriving at a maximum, when the copper and tin are united in the relation of 1 to 3. The density diminishes from this point, then rises again nearly regularly: the density of the richest copper alloys is inferior to the mixture SnCu_2 , which only contains 62 per cent of copper. Besides, this alloy may be distinguished from all the others by its properties; it is brittle enough to be pounded in a mortar, and forms crystals of a bluish tint, not resembling in the least either copper or tin. M. Riche gives a number of formulae, expressing the composition of the definite compounds which copper forms with tin and their properties. Referring to liquefaction, he then observes, "In order to separate these alloys, the mass should be moved about when becoming solid, to separate the crystals whilst forming." The fusibility of these alloys has been determined by the thermo-electric pyrometer. M. Riche has operated comparatively with these alloys, and with metals whose fusing points have been settled by various experimenters. Numerous determinations show that the solidification of the alloys SnCu_2 and SnCu , takes place at a temperature somewhere between the fusion point of antimony and the boiling point of cadmium.

M. Balard has presented a note from M. Berthelot, in which the union of free nitrogen and acetylene, and the direct synthesis of hydrocyanic acid are explained. Free nitrogen is distinguished by its indifference to most other bodies; it is only when under the influence of the electric spark that this indifference can be successfully combated, either with oxygen, as in Cavendish's celebrated experience, or with hydrogen, which leaves traces of ammonia. A new reaction of the same class is now to be noted, namely, the direct union of free nitrogen with acetylene, in which case hydrocyanic acid is found. Acetylene is

a hydrocarbon possessing remarkable chemical activity. Formed by the direct synthesis of the elements, it may afterwards be united with nascent or even free hydrogen to form olefiant or ethylene gas at first, and then hydride of ethylene; free acetylene may be combined directly with nascent oxygen to form oxalic acid. The metals of the alkalies attack it easily. This same chemical activity is also observable between acetylene and nitrogen in the free state. Thus, when a series of induction sparks is made to traverse a mixture of these two pure gases, the characteristic odour of hydrocyanic acid is soon perceived: the amount may also be estimated by the ordinary processes. In the circumstances just mentioned, the formation of hydrocyanic acid is accompanied by carbon and hydrogen, engendered by a distinct, but simultaneous, decomposition of acetylene. This complication may be avoided by adding to the mixture, beforehand, a sufficient volume of hydrogen, for example, ten times the volume of the acetylene: no deposit of carbon is then observed, and the reaction corresponds with the following equations: $-\text{C}_2\text{H}_2\text{N}_2 = 2\text{C}_2\text{H}_3\text{N}$. In other terms, the acetylene and nitrogen combine in equal volumes and without condensation. Cyanogen and hydrogen are combined in the same manner: $-\text{C}_2\text{N}_2 + \text{H}_2 = 2\text{C}_2\text{H}_3\text{N}$. The formation of hydrocyanic acid in the reaction of nitrogen upon acetylene commences rather rapidly, but very soon slackens. In an experiment made upon 160 c.c. of a mixture formed of 10 volumes of acetylene, 14.5 nitrogen, and 75.5 hydrogen, after passing sparks for an hour and a half, 8 c.c. (10 milligrammes) of hydrocyanic acid were obtained without any deposit of carbon: when the action slackens it may be started afresh by removing the hydrocyanic acid by means of a moistened fragment of potash, and then exposing the purified gas to the influence of sparks. The action always ends by slackening, in consequence of the gradual dilution of the acetylene.

By following up the experiment, a certain volume of acetylene may be made to disappear by placing previously in the epruvette a drop of a strong solution of potash, to absorb the hydrocyanic acid as fast as it is formed. In this manner 5-6ths of a known volume of acetylene may be changed into hydrocyanic acid. M. Berthelot explains the failure of the sixth part by the inevitable reaction of the vapour of water, which forms carbonic oxide and carbonic acid. This experiment required from twelve to fifteen hours' sparks. More than half of a known volume of nitrogen was changed into hydrocyanic acid in presence of an excess of acetylene; the rest would probably disappear after a much longer time. The presence of the hydrocyanic acid which is already formed, stops the reaction. This circumstance is easily explained. The mixture of hydrocyanic acid and hydrogen, traversed by a series of sparks, produces acetylene very quickly. Under the influence of the sparks, a certain variable equilibrium, according to the proportions, exists between hydrogen, nitrogen, acetylene, and hydrocyanic acid.

Pure nitrogen, under the prolonged influence of sparks, will not combine either with hydrogen or acetylene. Another interesting phenomenon occurs in the transformation of free nitrogen into hydrocyanic acid by union with acetylene. M. Berthelot states that all hydrocarbon compounds produce acetylene under the influence of sparks; thus it appears that nitrogen, mixed with whatsoever hydrocarbon vapour, should also form hydrocyanic acid. M. Berthelot has verified this fact with olefiant gas and with hydride of hexylene (from petroleum). In operating in presence of potash, Prussian blue is found among the products, after two or three minutes' sparks, an easy and sensitive test for nitrogen. M. Berthelot states in conclusion with reference to the chemical action of electricity that he has already observed that hydrocyanic acid is a body formed with absorption of heat from its elements; he now shows that hydrocyanic acid may also be produced by the direct union of carbide of hydrogen and nitrogen under the influence of the electric spark.

REPORTS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 26th, 1869.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the Chair.

"On Microscopical Examination of Dust," by J. B. DANCER, F.R.S.

The author stated that he had made some microscopical examinations of dust collected in June, July, and August last, and also of the particles contained in the rain water after the long drought. He had intended to bring these observations before the Society in a complete form, but has not hitherto found time to do so. He proposed to carry on observations during every month in the year, for the purpose of recording the average amount of solid matter deposited on a given area, and also as far as possible to ascertain the character of the deposits. The observations so far have shown, as might have been expected, that the dust in various localities, at different altitudes, and under other varying conditions, contained particles differing in magnitude, appearance, and quantity for the same superficial area. In every instance molecular activity was abundant, but the animal life was very variable in amount, the largest number of moving organisms being in the dust collected at the lowest points—this was about five feet above the surface of the earth. This dust also contained the largest proportion in magnitude and quantity of vegetable matter. These observations also show that in thoroughfares where there are many animals engaged in the traffic, the majority of the light dust, which when disturbed reaches the average height of five feet, or about the level of a foot-passenger's mouth, consists of a large proportion of vegetable matter which has passed through the stomachs of animals, or which has suffered partial decomposition in some way or other. This is not an agreeable piece of information, but it is a fact. It shows the necessity, in a sanitary point of view, of the streets being well watered before the scavengers are allowed to commence operations; otherwise the light dust is only made to change its locality, and is not properly removed. It is not pleasant to contemplate the possibility of germs of disease being wafted along with this decaying matter and inhaled by those whose condition might be favourable for its development. The author hopes to bring the details of these observations before the Society at some future time.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

February 1st, 1869.

J. B. DANCER, F.R.A.S., President of the Section, in the Chair.

Mr. JOHN BARROW read the following note "On a Comparative Analysis of English and Aleppo Galls."

When Mr. Sidebotham brought before the notice of this Section the subject of the large increase in the production of galls upon the oaks in this country, he expressed a wish that some member would make an analysis of them so as to confirm his experiments as to their value.

I requested Mr. Watson Smith, F.C.S., who is at present engaged in my laboratory, to undertake this task, and have pleasure in submitting to the Section his results. In order to make the analysis of practical value I suggested to him that he should examine both the English and Aleppo galls, and he has therefore experimented on the best sample of Aleppo galls I could procure and English galls obtained fresh from Cheshire.

The process used in both cases was that of Pelouze, viz., by crushing with ether; and, although this process is not absolutely accurate, it is the best one that Mr. Smith or myself could discover.

The results are—

	Aleppo Galls.	English Galls.
Gallo-tannic acid.....	61.65	26.71
Gallic acid.....	1.60	trace only
Woody fibre.....	15.68	47.88
Water.....	12.32	20.61
Colouring matter and loss.....	8.75	4.80
	100.00	100.00

Probably more gallic acid would be found if the galls had been gathered a longer time.

This analysis confirms Mr. Sidebotham's opinion of the value of the English galls, but does not make them quite as valuable as he puts them.

Ordinary Meeting February 23rd, 1869.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President in the Chair.

"On Sulphurous Acid in the Air of Manchester," by PETER SPENCE, Esq., F.C.S.

Believing, as I do, that the evils of our town smoke are in a much larger degree due to the gases which result from our coal consumption than to the black smoke, which is the one thing generally complained of and legislated against—it occurred to me that one of these gases, which has a most pernicious influence upon vegetation, and which can hardly be favourable as a constant breathing medium to animal life, could be made visible in its effects to the eye. This is sulphurous acid gas, a very considerable product of the combustion of coal, containing 2 per cent sulphur on an average.

The experiments I have made have been repeated some fifteen to twenty times, and in two localities; the results are evident, and are now before the Society. I used litmus papers, exposing one series of slips in the middle of the lawn at my house, at Smedley, about two miles nearly due north from the centre of the town, so that any wind between west, south-west, and east-south-east covers us with the smoke of a large section of Manchester, and, as these winds blow four-fifths of the year, Smedley has the lion's share of the town's smoke.

The slips were changed at eight in the morning and at six in the evening, so that they represent alternately day and night, and I may say that the results almost completely ignore the effects of large chimneys, the night slips being as decidedly acted upon as the day's, and none of them more so than the night between Saturday and Sunday morning. The effects are in remarkable connection with the state of the wind or set of the atmosphere, so much so that if shown a slip exposed there for twelve hours I could almost tell from it in what direction the wind had been. During most of the days and nights of exposure the wind was south, coming over the broadest section of Manchester; on Sunday it changed to east, coming over Harpurhey and Mosten; although the apparent smokiness was not much less, the colouring was slighter.

Gilda Brook, near Eccles, where the other slips were exposed, is west of Manchester, and fully three miles from the centre of the town, and there, even with an east wind, the diffusion of the gas is seen in the more slight colouring.

I am still continuing the exposures, and shall, probably, in addition to this, attempt to measure the actual quantity of SO₂ on some day when Smedley has the benefit of the fullest sweep of the Manchester atmosphere.

As to the effects of these gases upon vegetable life, I have full proof at Smedley; vegetable life on the whole of that side of town is a mere struggle for existence.

As an instance, as I am leaving it for the opposite side, where only a due north wind, which almost never blows, will bring me the smoke, I have been able to try its effects upon about twenty plants of camellias: these I had at Smedley, most of them for eight years, and the blooms had dwindled down year by year till, in the spring of 1868, I had only three or four miserable specimens. Early last May I moved them to the south side of town; nothing else was done to

them: they made their growth as usual, only more vigorously, and showed abundance of flower buds,—this they had frequently done at Smedley, but there they generally nearly all dropped off; this season they dropped none: they are now, and have for the last three weeks been, covered with beautiful blooms, and I have no hesitation in saying they have brought to maturity more in number than they did in all the eight years at Smedley.

The CHAIRMAN stated that he had made experiments many years ago on the air of Manchester, and had found a large quantity of sulphurous acid, which was frequently converted into sulphuric acid. There was also a large quantity of muriatic acid. These gases were brought down by every drop of rain, in sufficient quantity to redden litmus paper. He considered that smoke, as well as the gases, was very detrimental to both animal and vegetable life.

NEWCASTLE CHEMICAL SOCIETY.

THE third general meeting was held on Feb. 24th, Mr GLOVER in the Chair.

Dr. SCHWARZ read a paper "*On the Toxicology of the Cyanides.*" On the motion of the Chairman a vote of thanks was awarded to him.

Dr. LUNGE read, for Dr. CLEMM, a description of "*A New Volumetric Process for Sulphuric Acid and Sulphates.*" The method, which is of course incompatible with the presence of certain radicles, may be summed up thus:—Accurately neutralise, precipitate by excess of standard BaCl_2 , then add excess of standard Na_2CO_3 , make up to, say, 200 c.c., filter off 100 c.c., and titrate the unremoved carbonate.

Dr. LUNGE described at some length the modifications necessary in the case of pyrites, and cited test analyses which had given quite satisfactory results.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

A MEETING was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst., at eight o'clock in the evening, Dr. W. Wallace in the Chair.

One member was balloted for and declared duly admitted, and two candidates were proposed.

A lecture was delivered by A. S. HERSCHEL, Esq., B.A., F.R.A.S., "*On the Methods and Recent Progress of Spectrum Analysis.*" We shall give this lecture, either in full or in abstract, in as early a number as possible.

A meeting was held in the Hall, Andersonian University, on Monday, the 15th inst., at eight o'clock in the evening, Dr. Anderson, the President, in the Chair.

Two members were admitted by ballot.

W. H. PERKIN, Esq., F.R.S., read a paper entitled "*Observations on some Artificial Colouring Matters.*" We hope to be able to give a further notice of this paper in an early issue.

CHEMICAL SOCIETY.

Thursday, March 4th, 1869.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

The names of the following candidates for election were read:—

For the first time—Mr. W. H. Deering, Assistant Chemist in the War Department, 12, Surrey Square, Old Kent Road.

For the second time—Mr. T. Bolas, St. Mary's Hospital; Mr. W. F. Catchside, 12, St. Paul's Road, Camden Town; Mr. F. Clowes, 15, Cornwall Place, Holloway, N.; Mr. C. Hunt, London Gas Company, Nine Elms.

For the third time—Mr. J. J. Day, 173, Gloucester Road, Regent's Park.

The last-named gentleman was then duly elected by ballot.

The PRESIDENT regretted to have to announce that he had received a note from Dr. Frankland stating his utter inability to accept the office of president for the ensuing year. A new list would therefore be issued in a few days, in which the name of another gentleman would be substituted for that of Dr. Frankland.

Mr. TOMLINSON then read his promised lecture, "*On Catharism, or the Influence of Chemically Clean Surfaces.*" He commenced by referring to the previous researches of Oersted, Schönbein, and Liebig. In Oersted's researches, published in 1806, dilute acids were cautiously added, drop by drop, to solutions of alkaline carbonates; and similar experiments were made with other liquids. Almost no action took place at first; but on the introduction of any solid body, such as a platinum wire, a glass rod, or the finger, brisk effervescence occurs. He inferred that gas, in solution, is never given off except in contact with a solid, and he adduced the influence of solids in promoting crystallisation in support of his view. Analogous experiments were made by Schönbein in 1837, who suggested that the solids acted by carrying down air. Further illustrations were supplied by Liebig in 1839, who concurred in attributing the effects to the influence of the air introduced.

Mr. Tomlinson, after quoting these experiments, and giving some further instances of a similar kind, remarked that whether gas, vapour, or salt escaped from solution, most writers asserted the influence of some mysterious function in the air, while Gay Lussac imagined that the boiling point varied with the nature and condition of the vessel. In this he was followed by Löwel, who devoted eight or nine years to the investigation of supersaturated solutions. Mr. Tomlinson then explained the sense in which he applied the new term catharism (from *katharos*, pure or clean), distinguishing between "clean" in its ordinary and in its chemical sense. The finger could not be made chemically clean by any process, whereas a glass rod, cleansed with strong acids or alkalis, and well washed, was chemically clean, and no longer possessed the power of liberating either salt or vapour from liquids. The action of solid bodies in determining these changes he ascribes to the greasy film which, after exposure to the air, they are sure to acquire. For this film, the adhesion of the solid or vapour is greater than it is for the glass, and hence the effect of the solid. To such chemical uncleanness all phenomena of this kind should, he thinks, be ascribed, and he defines a nucleus as a body which "has a stronger adhesion for the gas, or the salt, or the vapour of a solution, than for the liquid which holds it in solution." He repudiates the notion that temperature has anything to do with the phenomena of supersaturation, and describes experiments in which supersaturated solutions of various salts were kept for hours in catharised vessels at a temperature of 10° F., without crystallisation taking place. This was even observed with alum, which does not usually exhibit this peculiarity. The views of Löwel on crystallisation, and the phenomena of *soubresaut*, or bumping, during ebullition, were next discussed, and a variety of interesting facts were described, for the particulars of which we must refer to the original paper. The action of porous bodies in assisting distillation was explained by their absorption of the vapour of the boiling liquids, which was subsequently given out in never-ceasing jets; and a number of obscure phenomena in chemistry—such as the passive condition of iron, and the slight action of sulphuric acid on pure and amalgamated zinc—were explained by the doctrine of catharism, for which the lecturer claimed the properties of a principle of nature—viz., generality and breadth of application—a principle which was as yet new to science.

The PRESIDENT, in offering the thanks of the meeting to Mr. Tomlinson for his interesting paper, remarked that the main point appeared to be to determine the bodies which had the power of liberating gases from solution. The phenomena were very complex, and he did not quite see that we had arrived at an explanation of them.

Dr. W. A. MILLER did not suppose that Mr. Tomlinson's experiments had brought us nearer to knowing the cause of the difference in adhesion of different substances, but he thought that some advance was made by Mr. Tomlinson in tracing a number of widely different phenomena to one very generally operating cause.

Professor WILLIAMSON referred to the experiments which Mr. Grove described to the Society some years ago, in which he failed to get any ebullition in the absence of gas, and remarked that we could hardly doubt that the presence of air was favourable to the process. He objected to the use of the term catharism, as tending to draw the attention off from the particulars of the evidence before the facts were sufficiently well known and classified. In reference to the use of the term, it was well known that nothing produced the crystallisation of supersaturated sulphate of soda so easily as crystal of the same salt, and yet it could not be said that such a crystal was not chemically clean.

Dr. GLADSTONE fully agreed that Mr. Tomlinson had cleared away the false explanations that had been given as to the influence of rough surfaces in promoting crystallisation on the evolution of gas, but doubted whether Mr. Tomlinson's theory was capable of explaining the phenomena in question. The nucleus, as Mr. Tomlinson defined it, had nothing to do with cleanliness or uncleanness. Paraffin might be made perfectly clean, and yet it would certainly produce the effect of recovering a salt from solution. It would be better, he thought, to get rid altogether of the words clean and unclean in this matter.

Mr. VERNON HARCOURT thought it an objection to the principle of the paper, that it was purely a negative principle. It would be more satisfactory if we could, as the President had suggested, learn of what kind the substances were which produced these results. In some recent experiments on the rate of decomposition of peroxide of hydrogen the speaker had found that when the dilute solution was heated in perfectly clean glass bulbs the evolution of oxygen was greatest; that it was less when the bulbs were not clean, and that it was reduced to a minimum by varnishing the bulbs inside. This seemed to be directly opposed to Mr. Tomlinson's theory.

Dr. ODLING believed that Mr. Tomlinson would be best rewarded for the interesting information which he had given by hearing the utmost possible number of objections to his views. He doubted Mr. Tomlinson's explanation of the action of nuclei in apparently homogeneous glass, and dissented from his conclusions on several other points. He remarked incidentally that it was scarcely fair to refer constantly to the very old experiments of Saussure's on the absorption of gases by charcoal, to the exclusion of the recent, and probably more accurate, experiments of Mr. Hunter. Mr. Tomlinson had found a new name for cleanliness, but had been more respectful to dirtiness. He said that catharism was a principle of nature, but it was open to question whether dirtiness had not a fair claim to be reckoned a principle of nature also.

Professor FOSTER did not think that Mr. Tomlinson had disproved De Luc's theory that air, or gas of some kind, was necessary for ebullition. The effect of cleaning a glass rod, for example, was, he thought, simply to cause the liquid to wet it more thoroughly, and so to exclude the film of air. He quoted a number of facts which seemed to support De Luc's theory.

Mr. HEISCH remarked that Mr. Tomlinson's theory could not apply to the passive condition of iron, because the immersion of only half an inch of an iron wire in strong nitric acid would render the whole wire, even 50 or 60 feet of it, passive to that acid, though not to another sample of it. The fact of the wire being cleaned by the nitric acid would not explain these facts.

Dr. CRACE CALVERT pointed out that acetic and carbolic acids possessed the same properties as sulphate of soda in a more remarkable degree. They might be shaken or stirred to any extent, with or without dirt, with any stirrers, clean

or dirty, and in vessels that were far from being chemically clean, and they would remain perfectly liquid, whereas the introduction of a crystal the size of a pin's head would render the whole mass solid in a few minutes.

Mr. TOMLINSON, in reply, expressed his thanks to the president and the other fellows present for their full discussion and free criticism of his paper. In regard to the action of charcoal, he could not imagine, that when a piece of charcoal was heated to redness in sand and then immersed in mercury or in a boiling liquid, there was much air remaining in it. It could only act in virtue of its capillarity. After answering some other objections which had been urged, he remarked that he did not pretend to explain adhesion, but that it could not be doubted that there were differences in adhesion. He commented on Mr. Grove's experiment, and expressed his desire to see it repeated under different conditions. He denied the peculiar power of producing crystallisation usually ascribed to a crystal of the same compound. He had suspended clean crystals of sulphate of soda in the neck of the flask during the boiling of the solution, and found that when he pushed the crystals down into the solution, after twelve or fourteen hours, no crystallisation was produced.

Most of the other objections alleged were then discussed in detail, but the time prevented the consideration of all of them.

The society adjourned until Thursday, March 18th.

Thursday, March 18th, 1869.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

PREVIOUS to the reading of papers, the President announced from the chair that it had been proposed to substitute the name of Dr. J. L. W. Thudicum for that of Mr. E. T. Chapman in the balloting papers for the Council. The proposal would be suspended in the Society's rooms, along with the printed list, according to the by-law.

Dr. GUTHRIE wished to know if he could make a resolution before the papers were read; but it was decided that it had better be left till the anniversary meeting.

A paper by Mr. ARTHUR ELLIOTT, "*On the Determination of Carbon in Cast-Iron*," was read by Mr. Vacher, who remarked that the great advantage of the process was that it had succeeded well in not very experienced hands, where other processes had failed. The author's method is adapted principally from Ullgren (*Anal. d. Chem. u. Pharm.*, 124:59), and consists in treating from 2 to 2.5 grammes of pulverised iron borings, rejecting any large pieces, with 50 c.c. of solution of sulphate of copper (1 in 5), heating gently for ten minutes, when the iron dissolves and metallic copper separates, the carbon remaining undissolved. 20 c.c. of solution of chloride of copper (1 in 2) and 50 c.c. of HCl are then added, and the mixture heated nearly to the boiling point, until the separated copper dissolves. The carbon is collected on a filter made of combustion tube, 15 c.m. long, one end being drawn out to a point 4 m.m. wide, and stopped first with broken glass, and then loosely with ignited asbestos, and washed with boiling water till free from chlorides. It is then converted into carbonic acid, and the latter determined, by transferring the carbon in the tube to a flask, adding 3 grammes of chromic acid; the flask is then supplied with a funnel tube and attached to a bottle one-third full of sulphuric acid, and this is connected with a U-tube, filled with pumice-stone saturated with sulphuric acid. This tube is connected with two smaller U-tubes, for absorbing the carbonic gas—one containing soda-lime, and the other pumice and sulphuric acid. 30 c.c. of sulphuric acid are gradually added to the flask, which is shaken, and the contents boiled for one minute; the tap of the funnel tube is opened, and a tube containing soda-lime connected; an aspirator is then applied to the small U-tube containing pumice and sulphuric acid, and air drawn at the rate of two or three bubbles per second.

The PRESIDENT thought that in rejecting any part of a

given sample which would not pulverise, there was a danger of rejecting a portion of iron having a different proportion of the metal to the carbon as compared with the rest of the sample. Mr. Forbes, who had given attention to the subject, would perhaps favour them with some remarks.

Mr. FORBES did not like to offer any opinion on the process till he had tested it himself. He had tried every process that had been made known, and was not at all satisfied of their great accuracy. He, and many others, would be very glad to submit the present process to enquiry, to determine its accuracy.

The next paper was a rather long one, by Mr. E. T. CHAPMAN and Mr. MILES H. SMITH, which was followed by a discussion. Owing to pressure of matter, we are compelled to postpone our report of it till next week.

Dr. ODLING then read a paper, by Professor G. G. Stokes, F.R.S., "*On a Certain Reaction of Quinine.*" The author stated that some time had elapsed since he had made these investigations, but not being a chemist, he had not ventured to lay the results before the chemical world; he had recently, however, been encouraged by a chemical friend to think that a fuller statement might prove of some interest to chemists. The reaction is best observed by diffused daylight entering a darkened room through a hole in the shutter of about 4 or 5 inches square, or a packing case may be made to answer very well. The hole is covered with glass coloured a deep violet by manganese. In front of it is placed a white porcelain tablet; a solution of quinine in very weak alcohol, or very small fragments may be used. In some cases, alcohol interferes with the reaction. The phenomena exhibited by sulphuric and hydrochloric acids were as follows:—When a drop of the quinine solution was touched by a rod dipped in dilute sulphuric acid, the fluorescence of the quinine was instantly developed. With hydrochloric acid, no apparent effect was produced, but hydrochloric acid destroyed the effect of sulphuric acid; and if a little sulphuric acid were added to the drop containing only hydrochloric acid, no effect was manifest. The author found that, on trying a variety of acids, they ranged definitely into two classes, A and B—class A developing fluorescence like sulphuric acid, and class B destroying it, like hydrochloric acid. The alkaline salts of the acids were found to destroy the fluorescence, as well as the free acids themselves. The following are the acids operated on by the author:—*Class A.* Acetic, arsenic, benzoic, chloric, citric, formic, hyposulphuric, iodic, malic, nitric, oxalic, perchloric, phosphoric, silico-fluoric, succinic, sulphuric, tartaric, and valerianic. *Class B.* comprises hydriodic, hydrobromic, hydrochloric, hydroferrocyanic, hydropalladiocyanic, hydroplatinocyanic, hydrosulphocyanic, and hyposulphurous. The character of the fluorescence of the salts of quinine in the solid state varies; the solid iodate obtained by precipitation is strongly fluorescent, with a blue considerably deeper than that of the solutions. The absorption of the fluorogenic rays by the yellow ferrocyanide of potassium would, in itself, account for the apparent destruction of the fluorescence, if the salt were present in sufficient quantity; but, to destroy the fluorescence, a less quantity is sufficient than would be required to prevent its exhibition by the absorption either of the fluorogenic or of the fluorescent rays, or of both; the author therefore concludes that the removal of the fluorescence is a true chemical reaction, and not a mere optical effect. The classification made by the quinine reaction agrees almost exactly with the old distinction of ox-acids and hydracids. The author had found, however, that hyposulphurous acid, which is not usually ranked with the hydracids, ranged itself in class B, and led him to seek for other analogies between hyposulphurous and the hydracids; and he found that hyposulphite of soda restored the blue colour to litmus which had been destroyed with chloride of mercury; he also found that, in common with the hydracids, it very readily decomposed oxide of mercury. Fluorescence had been restored without precipitation, in the case of hydrochloric acid, by the sulphate

or nitrate of the red oxide of mercury, and that the restoration of fluorescence was not a mere effect of the acid with the mercuric salt could be proved by adding just enough hydrochloric acid to destroy fluorescence in quinine dissolved in nitric or sulphuric acids; on stirring a little precipitated oxide of mercury in the mixture, the fluorescence returned. The fluorescence, destroyed by a chloride, was in some measure restored by nitrate of cadmium. The precipitate obtained with bromide of potassium was white, and showed a pretty orange fluorescence—a very unusual colour for the fluorescence of a white substance.

The PRESIDENT spoke of the importance of Professor Stokes's interesting paper; it was very possible that considerable light would be thrown on the nature of different chemical compounds by such facts as he had brought forward. Although spectroscopic analysis was more general in its application to rays of all refrangibilities, it would be of some value in dealing with the fluorescent rays, which are rays of one, or very few different, refrangibilities.

Dr. ODLING said that if he had not occupied too much time, he would like to make a remark on the composition of hyposulphurous acid, as to whether it was a hydracid or an ox-acid. Hyposulphite of soda was generally written by the formula $\text{Na}_2\text{S}_2\text{O}_3$, together with an atom of water, and the atom of water was essential to all the hyposulphites. If, instead of writing the formula in this manner, it was written $\text{Na}_2\text{H}_2\text{S}_2\text{O}_4$, it might represent the single or the double molecule of hyposulphite of soda. Assuming it represented the double, the formula for the simple hyposulphite would be NaHSO_3 , and that salt would correspond to an acid H_2SO_3 , of which the next term would be H_2SO_2 , and the next H_2SO . If this was the correct formula for hyposulphurous acid, it might evidently be regarded as a hydracid. Dr. Dupré had read a paper which contained this suggestion. He (Dr. Odling) thought that when Dr. Dupré brought forward this formula, he viewed it as the analogue of formic acid, and as, in that acid, one of the atoms was replaced to form formate of soda, so, in hyposulphurous acid, only one atom was replaced to form hyposulphite of soda; but if this were correct, it did not follow that this acid was the analogue of formic acid as regards its internal molecular arrangement. There was no doubt of formic acid being an ox-acid; but hyposulphurous, even with this formula, might be a hydracid. HCl represented hydrochloric acid, and HOCl, hypochlorous acid, so that the hydrogen was united to the chlorine by the oxygen, and it is a true ox-acid. The fact that NO_2 was capable, in a great number of cases, of taking the place of Cl made it an open question whether it was not a hydracid, notwithstanding its containing oxygen, on the assumption that hydrogen was not directly united with oxygen, as in the case of hypochlorous and cyanic acids. Nitric acid, HO, NO_2 , in which (assuming, from the nature of the body) the hydrogen is directly associated with the oxygen, is a true ox-acid, and starting from this point, we have hyposulphurous acid, which would be a true hydracid; sulphurous acid, which would be an intermediate acid; and sulphuric acid, which would be an ox-acid. The hyposulphites certainly corresponded with the halogen salts in their remarkable tendency to form double salts, the *raison d'être* of which was not satisfactorily established. The constitution of the double chlorides of mercury and sodium, and of mercury and ammonium, had not been accounted for on the ordinarily-received views of atomicity, unless Mr. Wanklyn's view was followed, and a higher atomicity given to them than was generally accorded. He (Dr. Odling) objected to elaborated formulae, for those chemists who wrote the formula of hyposulphurous with the two sulphurs written in different ways, and the oxygen in different ways, assumed that they knew all about it; but he thought there was a great deal to be learned, and the best way was to express it ordinarily, in the most compressed form, and then, as an illustration, put forward some further elaborated scheme, which might, and very likely might not, be true.

The PRESIDENT announced that the next meeting of the

Society would be the Anniversary Meeting, on March 30th, at 8 o'clock; and he asked as many gentlemen as possible to attend, as the officers would be elected and he would have to resign the Presidency.

PHARMACEUTICAL SOCIETY.

Wednesday, March 3rd, 1869.

H. SUGDEN EVANS, Esq., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed.

After some remarks from Professor Bentley on some specimens of dried herbs, and from Mr. Hanbury on a specimen of blackish green insect wax forwarded from India by Dr. Bailie.

Mr. C. H. WOOD proceeded to read a paper "On Sulphurous Acid." He found no difficulty in obtaining a 1.48 per cent solution in three hours, by passing a stream of the gas through water, and keeping the receiver as cold as possible; to obviate the inconvenience caused by a considerable amount of the gas passing off towards the end of the process, the operation can be carried on in the open air, but more charcoal and vitriol is required than ordered in the Pharmacopœia. The author preferred using a quicksilver bottle with a bent tube, to a glass retort. With regard to the test for strength, he had found that, by mixing 34.7 grains, by weight, with 1 pint instead of 1 ounce of water, as ordered in the Pharmacopœia, the proper proportion and accurate numbers were obtained.

Professor ATTFIELD confirmed Mr. Wood's statement regarding the test; he had thought the ounce was a misprint for a pint.

Professor REDWOOD could not plead that the ounce was a misprint for the pint, but he was of opinion that acid of the strength ordered in the Pharmacopœia was not so easily obtained or kept in a state of uniformity as one of much less strength. The committee of the Medical Council had sanctioned that the strength should be modified in the next edition of the Pharmacopœia, which, however, would not be published for some years; but as long as the process remained in the Pharmacopœia, it must be adhered to.

Mr. W. A. TILDEN, B.Sc., F.C.S., then read a paper "On Diluted Nitro-Hydrochloric Acid." The author had endeavoured to find out if there was any advantage or difference in the process of mixing the acids and allowing them to stand before diluting, or diluting the acids at the time of mixture. Six drams of the acid, mixed and diluted at once with water, required for neutralisation 90.4 grain measures of the volumetric solution of soda, while 6 drams of the official acid required 87.0 grain measures. The difference in the saturating power of the Pharmacopœia acid was accounted for by the loss of 1-50th of its volume. Nitric and hydrochloric acid being mixed with the water at the time, in such proportions as ordered, will give a liquid that will answer the tests and be the B. P. acid, although not according to its directions.

Professor REDWOOD said the reason for adopting the B. P. process was to get an acid at once that would contain free chlorine in solution. The process caused discussion in the Pharmacopœia committee—there was a contest as to how it was to be prescribed; if the acids were to be mixed in a bottle stoppered or open, perfectly or partially stoppered. By mixing the acid in a capacious stoppered bottle, saving the gas, adding the water gradually, and shaking, an acid is obtained with the contemplated proportion of chlorine.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

THERE was a meeting of this Society on Wednesday evening, March 10th, Sir D. CORRIGAN, Bart., in the chair. This meeting was the first of a series of intended joint meetings of the Royal Geological and Zoological Societies, to be held in the Museum Buildings of Trinity College.

Mr. M. H. ORMSBY, LL.D., of the Geological Survey of

India, read a communication, dated June 19th, 1868, from Mr. A. Dempster, describing the Prince of Wales gold mine at Sebastopol Ballarat. The paper was accompanied by specimens of the workings. The matrix yielded in washing 30 grains of gold for every 14 ounces.

NOTICES OF BOOKS.

"Obituary Notices of Deceased Fellows." (*Proceedings of The Royal Society*, Nov. 30th, 1868).

"Faraday as a Discoverer." By JOHN TYNDALL. Longmans, Green, and Co., 1868.

IN our impression of August 30th, 1867 (*Am. Repr.*, Nov. 6, 1867, page 268), we had the melancholy duty of announcing the death of our great countryman, Faraday. The short, and in many respects imperfect, sketch which we then placed before our readers was written hastily and under the influence of feelings which could not fail to suggest themselves at such a time.

Since then, affectionate friends, comrades, and fellow-labourers of the great philosopher* have, in the truest spirit of love and veneration, collected a mass of information regarding his life both as a man and an investigator, which we heartily recommend to the perusal of our readers. At the time when we wrote our first notice of Faraday, it was difficult to obtain reliable information regarding his early life and studies. His temperament was so completely averse to every kind of self-assertion or display, that it was necessary for him to die before all his greatness could be known. Fortunately for the world, two of Faraday's friends have had the means, the inclination, and the opportunity of giving us, not sketches, but finished pictures of his outer and inner life.

Even with the comparatively meagre information we possessed in August, 1867, we ventured to assert of Faraday that "he was the only man who has raised himself to the first rank in science in this country, whose every attribute we may fearlessly hold up as a model to our children!" If we wrote thus when we did, how much more shall we not repeat it with the light now before us? There can be no stonger proof of the goodness as well as greatness of Faraday than the deep affection with which he inspired his friends.

The obituary notice of Faraday in the *Proceedings of the Royal Society* is written by Dr. Bence Jones, and it is a model of what such notices should be. Instead of the feeble, rambling, and often half-hearted panegyrics we are so much accustomed to, we have a clear, well-written, chronological history of his life, occupying sixty-eight closely printed pages; but, owing to the perfect method and concise mode of expression, there is more matter in it than in two hundred pages written in the slipshod manner too commonly adopted by biographers. We shall make no apology for presenting our readers with an outline of Faraday's life, greatly condensed from Dr. Bence Jones's notice.

Æt. 1 to 12 (1791 to 1804).—Michael Faraday, the third son of James Faraday, was born at Newington, in Surrey, September 22d, 1791. His father worked as a blacksmith at Boyd's, in Welbeck Street, and, after living for a short time in Gilbert Street, they removed, when Michael was about five years old, to rooms over a coach-house, in Jacob's Well Mews, Charles Street, Manchester Square. This was the home of Faraday for nearly ten years, in fact, until 1809, when they moved to 18, Weymouth Street.

When thirteen years old (1804) he went on trial for a year to Mr. George Riebau, a bookbinder.

Æt. 13 to 19 (1805 to 1811).—On the 7th of October, 1805, Faraday was apprenticed to Riebau, and in consequence of his faithful service his master dispensed with a premium. Here Faraday first saw Mrs. Marcet's "Conversations on Chemistry," and the treatises on electricity in the "Encyclopædia Britannica." These works appear to have had the

* "Faraday loved this word and employed it to the last; he had an intense dislike to the modern term *Physicist*."—TYNDALL.

effect of giving him his first draughts of scientific knowledge. As may be supposed, he at once commenced making such experiments as were possible with his limited means.

At this period he also attended lectures on natural philosophy, given by Mr. Tatum.

Æt. 20 (1812).—Through the kindness of Mr. Dance, who was a customer of Riebau's, and a member of the Royal Institution, he was enabled to attend four of the last lectures of Sir H. Davy. At this period, "the desire to be engaged in scientific occupation, even though of the lowest kind, induced me, whilst an apprentice, to write, in my ignorance of the world and simplicity of my mind, to Sir Joseph Banks, then president of the Royal Society. Naturally enough, 'no answer' was the reply left with the porter."

He now began to construct small galvanic batteries; and the tenor of his letters at this date shows that his mind was entirely bent on scientific pursuits.

On the 8th of October he went as journeyman bookbinder to a Mr. De la Roche, a French emigrant, in London. This man was of a violent temper, and caused Faraday much trouble.

Encouraged by Mr. Dance, he sent Sir Humphry Davy the notes he had taken of his last four lectures. The reply he received was immediate, kind, and favourable. Although still working as a bookbinder, he at this period acted for a few days as amanuensis to Sir Humphry Davy, who was suffering from a wound in the eye received during his examination of chloride of nitrogen.

Æt. 21 (1813).—One night, while living in Weymouth Street, he was startled by a loud knock at the door, and a footman, who had alighted from a carriage, left a note for him from Sir Humphry Davy. This letter was to offer him a situation as assistant in the laboratory of the Royal Institution.

He was soon at work on various investigations for Sir Humphry; amongst others, on chloride of nitrogen. He had four violent explosions while engaged in its examination. One of these occurred while holding a tube containing $7\frac{1}{2}$ grains of the chloride. His hand was blown open and a part of one nail torn off. Fortunately, he wore a glass mask, which saved his eyes. As it was, the mask was cut by the pieces of the tube.

Æt. 22 (1814).—He visited Rome with Sir Humphry.

Æt. 23 (1815).—Still in Rome. His life at this time was to some extent troubled by the fact that Sir Humphry imposed tasks upon him connected with domestic duties, which should never have been proposed to him. It would appear, however, that Sir Humphry was very careful not to give him work which he disliked, as soon as his objection to it was known to him. Lady Davy, on the other hand, gave him much annoyance from her domineering propensities. A fortnight after his return to England, his salary as assistant in the laboratory was raised to 30s. a week, and rooms were given him.

Æt. 24 (1816).—He now gave lectures on chemistry, at the City Philosophical Society, and published his first paper, "An Analysis of Native Caustic Lime," in the *Quarterly Journal of Science*.

Æt. 25 (1817).—He published a paper "On the Escape of Gases through Capillary Tubes." He was also hard at work at his education.

Æt. 26 (1818).—Gave five lectures at the City Philosophical Society, and published six papers in the *Quarterly Journal*, the most important being "On Sounds produced by Flame in Tubes."

Æt. 27 (1819).—This appears to have been a comparatively uneventful year with Faraday.

Æt. 28 (1820).—First paper read before the Royal Society. It was "On Two New Compounds of Chlorine and Carbon, and on a New Compound of Iodine, Carbon, and Hydrogen." Experiments in conjunction with Stodart, on the alloys of steel.

Æt. 29 (1821).—His marriage, and admission into the Sandemanian Church. Paper in conjunction with Phillips "On a New Compound of Chlorine and Carbon." Succeeds in caus-

ing the wire to move round the magnetic pole and the pole round the wire.

Æt. 30 (1822).—Comparatively uneventful.

Æt. 31 (1823).—Papers in *Transactions of the Royal Society*. "On Fluid Chlorine," and "On the Condensation of several Gases into Liquids." Four papers in the *Quarterly Journal of Science*. Proposed as Fellow of the Royal Society. Elected Corresponding Member of the Academy of Sciences, Paris.

Æt. 32 (1824).—Elected Fellow of Royal Society, and of Geological Society.

Æt. 33 (1825).—Made Director of the Laboratory of the Royal Institution. Discovered benzol.

Æt. 34 (1826).—Paper "On Action of Sulphuric Acid on Naphthalin;" "On the Existence of a Limit to Vaporisation;" "On Pure Caoutchouc, &c."

Æt. 35 (1827).—Commenced researches on optical glass. Published his "Chemical Manipulation."

Æt. 39 (1831).—Published the first series of "Experimental Researches in Electricity."

Æt. 40 (1832).—Second series of "Experimental Researches in Electricity."

Æt. 41 (1833).—Third, fourth, fifth, and sixth series of "Experimental Researches." Elected Fullerian Professor of Chemistry.

Æt. 42 (1834).—Seventh, eighth, and ninth series of "Experimental Researches."

Æt. 43 (1835).—Tenth series of "Experimental Researches." Granted pension by Lord Melbourne. Awarded one of the royal medals by the Royal Society.

Æt. 44 (1836).—Appointed adviser to the Trinity House. Made senator of the University of London.

Æt. 45 (1837).—Eleventh series of "Experimental Researches."

Æt. 48 (1840).—Sixteenth series of "Experimental Researches." Appointed elder in the Sandemanian Church.

Æt. 51 (1843).—Eighteenth series of "Researches."

Æt. 52 (1844).—Paper communicated to Royal Society, "On the Liquefaction and Solidification of Bodies generally existing as Gases."

Æt. 53 (1845).—"Researches on Magnetisation of Light and the Illumination of Magnetic Lines of Force."

Æt. 56 (1848).—Twenty-second series of "Researches."

Æt. 58 (1850).—Twenty-third to twenty-seventh series of "Researches."

Æt. 61 (1853).—Sent to *Athenæum* his "Experimental Investigation of Table Turning."

Æt. 63 (1855).—Made Commander of the Legion of Honour.

Æt. 64 (1856).—Last paper sent to Royal Society: "Experimental Relations of Gold (and other metals) to Light."

Æt. 66 (1858).—Offered a house at Hampton Court by the Queen. Researches on Regelation, printed in Tyndall's paper "On Ice of Irregular Fusibility."

From this period, the record of his life ceases to be marked by events connected with his researches. He continued to give vast numbers of reports to the Trinity House, and at times gave lectures. But his health was rapidly declining, and his memory not to be relied on.

It need not be said that in the declining years of his life he was tended with unflinching devotion and care, not only by affectionate relatives, but by friends whose veneration and love were as great as it was possible for those of relatives to be. Tyndall gives the following touching account of the last time Faraday spoke to him (p. 168):—

"Sometimes, during the last year of his life, by the permission or invitation of Mrs. Faraday, I went up to his rooms to see him. The deep radiance, which in his time of strength flashed with such extraordinary power from his countenance, had subsided to a calm and kindly light, by which my latest memory of him is warmed and illuminated. I knelt one day beside him on the carpet, and placed my hand upon his knee; he stroked it affectionately, smiled, and murmured in a low soft voice the last words I remember as having been spoken to me by Michael Faraday."

It is charming to find throughout Tyndall's entire work

such a deep reliance on the goodness and kindness of Faraday. He is not, however, a mere blind adorer; he analyses with wonderful skill Faraday's mental process, and wherever he feels it is his duty to differ with him he does it faithfully, but with the gentleness and tenderness of a loving son.

Every one who has read attentively Faraday's paper "On the Magnetisation of Light and the Illumination of the Magnetic Lines of Force," must have been surprised at its title; the writer well remembers how intensely he was puzzled by it. Dr. Tyndall says on this subject, "In November, 1845, he announced his discovery of the 'Magnetisation of Light and the Illumination of the Lines of Magnetic Force.' This title provoked comment at the time, and caused misapprehension. He therefore added an explanatory note; but the note left his meaning as entangled as before; in fact, Faraday had notions regarding the magnetisation of light which were peculiar to himself, and untranslatable into the scientific language of the time. Probably no other philosopher of his day would have employed the phrases just quoted as appropriate to the discovery announced in 1845. But Faraday was more than a philosopher; he was a prophet; and often wrought by an inspiration to be understood by sympathy alone." Then, after a lucid explanation of the experiment itself, Tyndall goes on to say, "His magnet turned the plane of polarisation of the beam through a certain angle, and thus enabled it to get through the analyser, so that 'the magnetisation of light and the illumination of the magnetic lines of force' becomes, when expressed in the language of modern theory, the rotation of the plane of polarisation."

We need not say that, if Dr. Tyndall was happy in the friendship of Faraday, Faraday was to be congratulated that his mantle (which Tyndall modestly says is almost too heavy to be borne) has fallen upon such shoulders.

Dr. Tyndall's work is illustrated by two exquisite portraits of Faraday. The frontispiece is engraved from a negative taken some years ago specially for Dr. Tyndall. The portrait facing p. 79 is a gem in its way. It is from a daguerrotype by Claudet, taken when Faraday was about fifty years old. We consider, however, that the engraving we present to our readers this week is a still more striking likeness of the great philosopher. It is printed from a block in the possession of the Editor, and is probably not to be surpassed in vigour and truthfulness.

In conclusion, we earnestly recommend Dr. Tyndall's work, not merely as a charming biographical sketch, but as a masterly analysis of the mind of one of the greatest and best men the world has ever produced.

CORRESPONDENCE.

On Phosphorus in Iron and Steel.

To the Editor of the CHEMICAL NEWS.

SIR,—I am sorry to see that Dr. Paul, in replying to my letter on the above subject, has merely perpetrated a few commonplace sarcasms, which cannot throw any light upon the chemical relations of phosphorus to iron, and which were certainly not called for by any remarks of mine.

That the fallacy I referred to does exist somewhere outside of my imagination, can be seen at once by reference to the CHEMICAL NEWS of Jan. 29th, p. 58 (*Am. Repr., March, 1869, page 146*). Anybody who refers to that report—the accuracy of which Dr. Paul does not question—will see that he commences with the statement that "It is generally considered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal," and that "quite recently an eminent metallurgist has stated, as a fact, that much less than 0.3 per cent of phosphorus produces a decided and injurious effect upon steel." He then proceeds to controvert that statement, and bases his controversion on the fact that "he had recently had an opportunity of testing the truth of this conclusion by determining the phosphorus in some samples of iron and

steel," &c. He then states *how* the quality of these seven bars of iron and two bars of steel was tested—viz., by Mr. Kirkaldy's tensile strain and extension tests; he gives Mr. Kirkaldy's figures, and those of his own analyses, and finding that the iron and steel containing so much phosphorus stood these mechanical tests so satisfactorily, he "therefore thinks himself justified in asserting that the commonly-received opinion on this subject does not always represent the truth."

The object of my letter was to show that this reliance upon the gradually applied tenacity and extension tests is fallacious; that these tests, though of great practical value in determining some points, do not detect the special mischief which phosphorus, in small quantities, does to iron and steel. It was quite evident, from the discussion which followed the reading of Dr. Paul's paper in the Chemical Society, and from expressions of opinion recently made in other places, that Dr. Paul is not the only one who has been misled by the application of these tests, which, as I explained, may even represent all kinds of malleable iron, and some kinds of steel, as actually improved by the addition of a little phosphorus, on account of the increased tenacity of a peculiar kind which it confers.

When I referred to my own position as chemist to one of the largest and most important iron-works in Europe, it was not, as Dr. Paul insinuates, with the view of self-exaltation, but to indicate, that, in pointing out a mistake made by him and Dr. Miller, I was merely correcting a technical error, which any chemist, not having such daily and special "opportunities of comparing the results of chemical analysis with the verdicts of practical trials," would be liable to make.

I confined myself to a general statement of the facts (Dr. Paul seems to regard brittleness, tenacity, hardness, cold-shortness, &c., as only "opinions") best known concerning the special characters of the deterioration produced by phosphorus, simply because my letter had already made a sufficient demand both upon your columns and my time; but if the subject is considered sufficiently interesting, I shall be happy to take an early opportunity of supplying you with some illustrations of the special instances from which the general inductions are derived.—I am, &c.,

W. MATTHEU WILLIAMS.

The Laboratory, Sir John Brown and Co., Sheffield.

[Our correspondent will confer a favour on our readers by communicating the valuable information he so kindly volunteers.—*Ed. C. N.*]

Spurious Guano.

To the Editor of the CHEMICAL NEWS.

SIR,—Dr. Paul, in your last impression (*Am. Repr., April, 1869, page 213*), has a letter with the above heading, containing, as I think, a very unjustifiable attack upon the manufacturers of a manure called "Biphosphated Peruvian Guano." He says, "It is not Peruvian guano at all;" that "it more nearly resembles superphosphate of lime;" that "it is not worth one-half the price asked for it;" that "it contains not much more than one-third the quantity of ammonia in Peruvian guano," and that it is a trashy manure. Surely Dr. Paul cannot be very familiar with the subject on which he writes, when he ventures to make these statements? I have no desire to speak harshly of Dr. Paul, who may be acting under some misapprehension, or to question the propriety of admitting into your valuable journal a letter intended to be very damaging, without some inquiry, when at least a week must pass before any reply can be made, but, as I have been frequently consulted upon the subject of this manure and its manufacture, and have made repeated analyses of the products, I think it necessary to say a few words in answer to Dr. Paul. The works are freely open to me, and I have constant opportunities of watching every stage of the processes, but, whilst I have neither the

nor the inclination to disclose the methods adopted, I may say that they are perfectly simple and straightforward; there is no mystery either in the name or in the composition, the former pretty nearly indicating the latter; and in reference to its composition, it does actually contain more than 50 per cent of the fine Peruvian Government guano; more than 24 per cent of phosphate of lime, of which 21 per cent, at least, is soluble; 6 per cent of alkaline salts; and 7 per cent of ammonia. Dr. Paul says there is no Peruvian guano at all, and that this is a "trashy manure." Dr. Voelcker, Dr. Anderson, Professor Way, Mr. Sibson, and myself differ with him on all points, and, as I cannot ask you to include their opinions at length in my letter, I beg to refer to your advertising columns for their analyses in detail, to their reports upon the value of the manure for all purposes.—I am, &c.,

G. H. OGSTON.

22, Mining Lane, E. C., March 2nd, 1869.

To the Editor of the CHEMICAL NEWS.

SIR,—With reference to a letter from Mr. B. H. Paul, which was contained in your last week's number (*Am. Repr.*, April, 1869, page 213), Mr. Ogston has informed us that he has thought it well to make some reply to Mr. B. H. Paul, and we will, therefore, only ask your readers' attention to the testimony borne to the value of this manure by the best authorities on agricultural chemistry, contained in their published analyses and reports, and inserted in your present number as an advertisement, itself an answer most complete to anything Mr. B. H. Paul may say.

We may add that we immediately commenced proceedings at law against Mr. B. H. Paul, for the statements contained in this letter.—We are, &c.,

REES AND CO.

32, King William Street, E.C., March 2nd, 1869.

Notes on Lecture Experiments.

To the Editor of the CHEMICAL NEWS.

SIR,—Some time ago I called attention to the subject of lecture experiments, and stated that it would be of great service to those engaged in the work of science teaching if occasionally hints were thrown out in the columns of your journal for the proper performance of such experiments as one meets with in ordinary manuals, but which, in the majority of cases, are most incompletely put before the reader, as those who attempt to repeat the experiments soon discover. It is true the experimenter may soon find out the cause of failure and remove it, especially if he be one accustomed to lecture demonstration, but there is surely no necessity for hundreds of persons each to overcome the same difficulties, when a few lines in this column from any one of them would save trouble to the whole. Lecture experiments or more properly *demonstrations* are invaluable as a means of impressing facts upon the minds of students in science, and it appears to me that sufficient importance is not given to them in manuals. Besides this, as an additional and perhaps more weighty argument for a column specially devoted to lecture experiments, there are continually new modes of demonstration being devised, but for want of a recognised journal in which to record them they are lost, except to the few who may have been present when they were exhibited.

I would venture to ask you, sir, in the name of myself and several of my friends who are engaged in science teaching if you would allow a column occasionally in your journal for notes and queries respecting lecture experiments, not doubting, from the reasons I have given above, that by so doing you would be conferring a favour on a large number of your readers.—I am, &c.,

Midland Institute.

C. J. WOODWARD.

Spurious Guano.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to the objections raised by your correspondents, Messrs. Rees, to my remarks on this subject, I beg to say that those remarks were based upon the analysis and account given of the manure by themselves; that in those remarks there was not anything either "unwarrantable" or "set against" the analysis and reports since published in your columns, which confirm, as might have been expected, the analysis by Mr. Ogston, and furnish the most complete justification I could wish for of my estimate as to the value of the manure.

The analysis and reports on this manure do not bear out the assertion that "it is undoubtedly the most valuable that has yet been offered to the farmer," or the statement that the chemists referred to give "the highest opinions" of the value of this manure, nor do they accord with the statement that, in reference to its composition, it is a cheap manure, for none of the chemists named put an actual money value on the manure, but merely term it "a very valuable manure," which may fairly be said of it or of any other manure worth more than £5 per ton; and Dr. Voelcker's recommendation is judiciously qualified by the proviso "if it can be sold at a reasonable price."

The manure is said to consist of a "basis" of Peruvian Government guano, but, at any rate, it contains, "amongst other ingredients," superphosphate of lime, which is of lower value than that guano.*

As my friend, Mr. Ogston, has thought it necessary to say a few words in reply to me, the fitness of which, from his point of view, I can appreciate, and am quite willing to admit, it is with much regret that I see he has gone out of the way to charge me with having made a very unjustifiable attack upon his clients, and to misrepresent me as having stated there was "no Peruvian guano at all" in the manure. No such statement was made by me. Mr. Ogston is also in error in stating that Dr. Voelcker, Professor Anderson, Mr. Way, Mr. Sibson, and himself, differ from me on all points. This is not the case; for the analyses of those gentlemen are, in fact, the basis and justification of my opinion. Mr. Ogston has, of course, full right to hold or express a different opinion, but I venture to think he is not justified in presuming to assert that I cannot be familiar with the subject on which I wrote, and in doing this he has gone beyond his province. Mr. Ogston, I am sure, is sufficiently conversant with the value of manures that, if his client were a farmer, he would not assign to a manure having the composition represented by his analysis a value of £11 per ton; and I do not believe that in any case he would have certified such to be the case.—I am, &c.,

B. H. PAUL.

8, Gray's Inn Square, March 6th, 1869.

Chemistry of Sugar Refining.

To the Editor of the CHEMICAL NEWS.

SIR,—In No. 472 of volume xviii. (*Am. Repr.*, Feb. 1869, page 76) of your excellent publication is an able and exhaustive paper by Dr. Wallace, "On the Chemistry of Sugar Manufacture and Sugar Refining," wherein occurs a passage to which exception must be taken, as it is of a nature to create false impressions.

After speaking of the injurious action of weak acids which invert cane sugar, and enable liquors to dissolve iron from animal charcoal and from iron tanks and cisterns, besides other impurities, Dr. Wallace adds, "In this way Mr. Beanes's process for treating animal charcoal with hydrochloric acid gas, although otherwise all that can be desired,

* Owing to the pressure on our space, we are obliged to omit from this letter a tabular comparison of the published analysis of the guano under discussion, with an analysis of Peruvian guano made in 1856 by Mr. Way.

has entirely failed, and has caused ruinous expense to some refiners who have used it."

While admitting the premises of Dr. Wallace, I fail to see how he arrives at his conclusion. Were it true that Mr. Beanes's process produces weak acids, the conclusion would be perfectly legitimate.

I feel authorized to speak on the subject of Mr. Beanes's process for purifying bone-black. I was one of the first in the United States who became acquainted with the process, and for the last two years I have had charge of it at the Refinery of Messrs. Havemeyers and Elder, in Brooklyn, E.D., opposite New York. They refine 100 tons of sugar daily, and treat weekly 220,000 lbs. of bone-black by the process of Mr. Beanes. They have now three large apparatus for making the hydrochloric acid gas in constant operation, and are putting up more retorts.

In view of my experience, I deny that weak acids must necessarily be formed in the sugar solutions by the use of Mr. Beanes's process, except under the most careless and unskillful management. Only two circumstances can give rise to the formation of weak acids in connection with the process of Mr. Beanes. Either the bone-black is left acid and the liquor dissolves acid from the bone-black, or the water left in the bone-black weakens the liquor sufficiently to allow fermentation to take place readily.

At the refinery of Messrs. Havemeyers and Elder there is no trouble from either cause of acidity. The sugar solutions after filtration are neutral.

I am led to believe, from the passage of Dr. Wallace's discourse quoted above, that an account of the means we employ to avoid acidity in the bone-black would be of use to the refiners in England who purify their bone-black by Mr. Beanes's process. I may briefly state that acidity is prevented in the bone-black—

1. By using peroxide of manganese in the hydrochloric acid generator, to avoid the formation of sulphurous gas.
2. By saturating the bone-black with hydrochloric acid gas only when it is dry and very hot, as it comes from the revivifying kilns.
3. By using the hydrochloric acid gas dry.
4. By allowing the saturated bone-black to stand in suitable receivers till the excess of gas, if any, is absorbed before washing.
5. By washing the bone-black thoroughly after saturation to remove the chloride of calcium and other soluble salts.

It may be well to state that the use of wet bone-black in the filters consequent on the employment of the process of Mr. Beanes, is not of itself a cause of acidity in a refinery. On the Continent of Europe, and I believe in England, the bone-black is often used wet in the filters without any harm resulting from this practice. Differences of results obtained from the use of wet black must be due to differences of management.

In the two largest refineries in the United States, that of Messrs. Havemeyers and Elder of New York, and the Franklin Sugar Refinery of Philadelphia, also at Las Canas, the Sugar Estate of Don Juan Poe, the scientific planter of the island of Cuba, the process of Mr. Beanes has been adopted, is working successfully, and the best results have been obtained.

Dr. Wallace renders a just tribute to the process of Mr. Beanes when he says that it is "otherwise all that would be desired." I am able to add that it is not necessarily a source of acidity in a refinery.

The apparatus in use at the above-mentioned establishments differs from the one previously in use in the manner of drying the hydrochloric acid gas, which is accomplished without the use of chloride of calcium.

Hoping that the above may prove useful to the sugar refiners of England,—I am, &c.,

P. CASAMAJOR.

98, Wall Street, New York,
February 22nd, 1869.

The New Earth in Some Zircons.

To the Editor of the CHEMICAL NEWS.

SIR,—The history of the discovery of absorption bands in certain zircons is so thoroughly given in the CHEMICAL NEWS for the 12th inst. (*Am. Repr., May, 1869, page 231*), that I am reluctant to trouble you with any further communication on the subject. Yet I cannot refrain from commenting on three or four remarks in Mr. Sorby's valuable letter therein given.

1. Mr. Sorby says that I observed (1866) the spectrum of the new element in a "very imperfect manner." But the new spectrum which was then described was soon found to be more complex; while a rough pen and ink sketch in a letter was not likely to represent it faithfully. But how does my drawing really differ from Mr. Sorby's? The chief differences arise, not from the imperfection of my observation, but from the intense absorptive power of the specimen of jargon from which I drew the figure. This caused at once a broadening of the bands, and in some cases a coalescence of two bands into one. But after all it will not be surprising if the greater skill and better instruments of Mr. Sorby have enabled him to make a more accurate drawing.

2. My remark as to the Ceylon and Norway zircons showing the bands referred, of course, only to those few transparent specimens which I then possessed. I have since met with many stones from both localities which showed either no bands or mere traces of bands.

3. Mr. Sorby says I was led to conclude that the production of the bands might depend on the presence of Svanberg's norium. I "hazarded the conjecture," but all I concluded was, that the presence of these bands in the spectra of some zircons and their absence from others showed that the bands must be due to some substance other than zirconia.

4. In conclusion, I may say that my studies and analyses of several well-marked black-band zircons have convinced me that the new earth will not be found "to constitute the chief ingredient of some of the jargons from Ceylon;" I very much wish that this was likely to be the case.

I reserve a fuller account of my results till they have been rendered more complete by further research. I propose to continue to devote my attention to the chemical and analytical side of the inquiry; the physical study of the zircon could not have fallen into more appropriate or abler hands than Mr. Sorby's.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester,
March 15, 1869.

Biphosphated Peruvian Guano.

To the Editor of the CHEMICAL NEWS.

SIR,—In spite of Mr. B. H. Paul's attempted explanation of his first letter, and his assertion that the analyses of our manure justify the use of the expressions contained in that letter, we still think his attack unwarrantable.

We decline further correspondence with Mr. Paul, but as we are bringing our action against him with as little delay as possible, he will have another opportunity of explaining his views on the subject.—We are, &c.,

REES AND CO.

32, King William Street, London,
March 16, 1869.

The Chemistry of Sugar Refining: Beanes's Process for Purifying Bone-black.

To the Editor of the CHEMICAL NEWS.

SIR,—Will you kindly afford me space to explain the cause of the apparent inconsistency between the views advanced by Dr. Wallace on the above subject and the Casamajor has embodied in the last week?

The fact announced by Dr Wallace, that "acids invert cane sugar," has been known to me for the last thirty years, and is, I believe, familiar to most persons engaged in the sugar manufacture. So well, indeed, is it understood in America and on the continent of Europe, that every precaution is taken to neutralise the acidity of the crude sugar before submitting it to the action of the animal charcoal. This practice does not prevail in England; sugar refiners here trust to the calcic carbonate present as an impurity in the charcoal for the neutralisation of the acid of the sugar; and, as my process removes this calcic carbonate, it renders the charcoal less suitable for the rude and unscientific method in vogue here, than it is for the greatly superior method adopted in countries where the manufacture is better understood.

The decolourising effect of bone-black upon syrup is in proportion to the extent of carbon surface exposed. The smaller the grains the greater is the decolourising effect produced; and yet our sugar refiners load with calcic carbonate—*whitenash*, as it were,—the very carbon surface upon which they depend for the decolourisation of their syrups! The practice seems to me, I confess, irrational in the highest degree.

Old bone-black, freed from lime and other impurities, is inferior in power to new, because its carbon surface is less. Its innumerable little prominences have been removed by friction, it has become polished, and the extent of surface which it exposes is thereby reduced, but it is nevertheless, as might have been expected, very much more efficient than a similar black from which the calcic carbonate has not been removed.—I am, &c.,

Cordwalles, Maldenhead, Berks,
March 15th, 1869.

E. BEANES.

The Chemical Society.

To the Editor of the CHEMICAL NEWS.

SIR,—As the writer of the letter which was read from the chair at the last meeting of the Chemical Society, proposing that the name of Mr. Ernest Theophrastus Chapman should be replaced by that of Dr. J. L. W. Thudicum as one of the new members of Council, I shall be glad if you will kindly afford me the opportunity of giving the reasons which induced me to take so decided a step.

Of Dr. Thudicum, I may remark that he is a gentleman holding a high official position; his advice and assistance on scientific and chemical subjects are frequently sought by different departments of Government; and his researches in spectrum analysis, and elaborate investigations on chemical pathology in connection with the cholera, are of very high scientific value, besides being of almost national importance. Besides this, the gentleman I have the honour to nominate has the advantage of five years' seniority in our society over Mr. Chapman. Of the latter gentleman, I do not wish to say anything that can detract from his known ability, but think that the interests of the society would not suffer from his absence from the governing body—at least until his judgment is a little more matured.—I am, &c.,

JOHN SPILLER.

[We feel it our duty to allow Mr. Spiller the opportunity of stating the reasons which induced him to write the letter which was read from the chair at the last meeting of the society. According to the fifth by-law, our correspondent's proposal, after having been read from the chair, is to be publicly suspended in the society's rooms with the list recommended by the council. The balloting papers, which have now been sent to all members of the society, contain a notice which is intended to meet such a case as this. They state "If you wish to substitute any other man in place of that proposed, erase the printed name in the second column and write opposite to it in the third that which you wish to substitute."—*Ed. C. N.*]

Sudden Crystallisation.

To the Editor of the CHEMICAL NEWS.

SIR,—I should be glad to know the best method of preparing a solution of Glauber's salts for showing sudden crystallisation. My principal difficulty is in avoiding the breakage of the glass flask in which the solution is prepared. I am speaking now of a quantity suitable for a lecture experiment—say a solution containing 10 or 15 lbs. of the salt.

CRYSTAL.

To burn Oxygen or Air in Hydrogen or Coal Gas, to show that Combustible and Supporter of Combustion are Relative Terms.

To the Editor of the CHEMICAL NEWS.

SIR,—The following simple arrangement does very well indeed for experiments of this character:—A piece of glass tube, a foot or so in length and about an inch in diameter, is fitted with a good cork at each end. Into one of the corks is inserted a short piece of glass tubing, $\frac{1}{2}$ inch in diameter, to which is attached a piece of caoutchouc tubing provided with a pinch-cock. The other cock is perforated, and a metal tube, 2 or 3 inches long and $\frac{1}{2}$ an inch or so in diameter, is inserted into the cock, but does not pass through it. The tube is filled with hydrogen or coal gas. For this purpose it is clamped upright, metal tube downward, and the gas is let in at the top through the caoutchouc tube; when full, a light is applied to the gas at the extremity of the metal tube, and the pinch-cock turned, until the supply of gas is reduced so that there is a small flame only from the metal tube. A glass tube, about $\frac{1}{2}$ inch diameter and terminating in a moderately fine jet, is now connected with a bag, or gas-holder, containing oxygen, the oxygen turned on, and the glass jet, with the issuing oxygen, passed through the metal tube into the glass one, when the oxygen, lighted as it enters, will burn in the glass tube containing the coal gas or hydrogen. To burn air, a similar small tube is taken, but with a large jet; the tube is connected by caoutchouc piping with a common pair of bellows, and then, while an assistant gently blows air from the bellows through the glass tube, it is passed through the metal pipe, when the air will burn in the same manner as the oxygen, but with a feebler flame. To burn the breath, an experiment, I believe, shown for the first time by Dr. Odling, the same small tube may be used as the one just now mentioned, air being gently blown from the mouth while the tube is introduced into the hydrogen. The following are the conditions, or essentials of success, in the above experiments:—(a) The glass tube must be completely filled with gas before lighting, that no explosion may occur. (b) The delivery (glass) tube, connected with the bellows or the mouth, must be sufficiently large, and the air must be driven through the tube gently. (c) In passing the ignited air into the glass tube, the jet should not touch the metal pipe, as it may be extinguished on its passage. A paraffin lamp chimney will serve very well instead of the straight glass tube spoken of, and is, perhaps, more easily obtained. There is one circumstance which mars this experiment to some extent, and that is the deposition of moisture on the interior of the tube, which soon accumulates to such an extent as to prevent the audience from seeing clearly the burning air within. I should be glad of any hint for a method of preventing this deposition of moisture.

C. J. WOODWARD.

Midland Institute.

The Non-Precipitation of Sulphide of Manganese.

To the Editor of the CHEMICAL NEWS.

SIR,—In the short communication which Professor How, of Nova Scotia, addressed to you last week (*Am. Repr.*, May, 1869, page 236), entitled "On the Non-Precipitation of Manganese by Sulphide of Ammonium in presence of some Organic Ammoniacal Salts," your correspondent evidently writes under the impression that the remarkable behaviour

of this metal under the circumstances mentioned by him has not been previously noticed or described, and in giving you his results he naturally refers to them as "possessing novelty and interest." I have, however, to request the favour that you will allow me to point out the fact that the reactions in question formed part of a communication which I read at a meeting of the Chemical Society of London as far back as the 16th of March, 1857. My paper (of ten pages) contains a long inventory of cases in which citric, tartaric, and other organic acids were found to exert important influences on a variety of chemical reactions; and in the title, I specifically referred to these effects as "remarkable circumstances tending to disguise the presence of various acids and bases in chemical analysis." One of the most striking anomalies observed by me was the non-production of the ordinary precipitate upon mixing chloride of barium with a soluble sulphate, when an alkaline citrate was present in the same solution.

The sulphides of manganese, arsenic, and platinum were those which showed to the greatest extent the interfering action of the citrates, and the effect of tartaric acid was observed as being exerted in the same direction. I quote from the *Quarterly Journal of the Chemical Society* two or three paragraphs descriptive of the modified reactions of manganese:—

"*Oxide of Manganese.*—The most striking result observed under this head relates to the behaviour of the sulphide. The flesh-coloured precipitate usually obtained on adding sulphide of ammonium to a salt of manganese does not appear under these circumstances, and the sulphide, after precipitation, is freely soluble in an alkaline citrate. If citrate of ammonia be the solvent employed, vapour of sulphide of ammonium is evolved on boiling. The protoxide of manganese is not precipitated by potassa, nor the carbonate by carbonate of soda, in presence of a soluble citrate."

"*Tartaric acid* prevents the precipitation of a salt of cobalt by potassa, and, in the form of a neutral tartrate, retains in solution sulphate of lead and the sulphide of manganese. Prussian blue is not formed in its presence; and the precipitation of sulphate of baryta is to a small extent retarded."

"*Grape sugar*, likewise, prevents, in the cold, the formation of sulphide of manganese. Neither cane nor milk-sugar appeared to have any influence in this direction."

It will be seen, therefore, that although the results of Professor How are undoubtedly interesting, they fail to possess also the charm of novelty. Many an old fact has gained importance by being recited, and I think that the suggestion of the interference being due to the production of mangano-ammonium may possibly receive confirmation from the parallel circumstances observed in the case of arsenic, with the alternative of referring them, in other cases, to the existence of a class of double citrates, as indicated in my paper twelve years ago.—I am, &c.,

JOHN SPILLER.

London, March 22nd, 1869.

The Chemistry of Sugar Refining.

To the Editor of the CHEMICAL NEWS.

SIR,—In your issue of this week (*Am. Repr.*, May, 1869, page 259), there is a letter from Mr. E. Beanes, which seems to call for a brief reply from me.

Mr. Beanes makes it appear that I "announced" the fact that "acids invert cane sugar" as an original observation, and rejoices in having known it for the last thirty years. I need scarcely state that "the fact" is one of the first with which students of organic chemistry are made acquainted.

Mr. Beanes further states that "our refiners load with calcic carbonate the very carbon surface upon which they depend for the decolourisation of their syrups!" This is, as applied to British refiners, simply absurd. The calcic carbonate, which is not an impurity, as Mr. Beanes states,

but an essential constituent of animal charcoal, continually decreases with use, and, occasionally, almost entirely disappears.—I am, &c.,

WILLIAM WALLACE.

Glasgow, March 27th, 1869.

Apparatus for showing the Reciprocal Nature of Combustion.

To the Editor of the CHEMICAL NEWS.

SIR.—I have taken much interest in Mr. Woodward's descriptions of lecture experiments, and it affords me great pleasure to be able to help him. The apparatus I employ for showing the reciprocal nature of combustion is modified from that described in Bloxam's "Chemistry." It consists of a paraffin-lamp glass, placed in an erect position and closed at both ends by perforated corks. Through the lower cork pass a narrow glass tube, for the admission of coal gas or hydrogen, and a wide tube of brass extending about half an inch on each side of the cork. The upper end of the lamp glass has a perforated cork and a short glass tube, to serve as an exit for the products of combustion. This seems to be missing in Mr. Woodward's apparatus. This coal gas is first turned on full and lighted at top and bottom, and then, by diminishing the supply of gas, a flame of air is obtained at the interior end of the brass tube, and may be exchanged for oxygen or chlorine at pleasure. By blowing out the upper flame, the apparatus shows the production of acetylene, and by extinguishing the air flame, it affords a good illustration of the theory of the Bunsen flame. No moisture is deposited, the air flame burns continuously, and frequently produces a musical note. Mr. Woodward should admit his coal gas below, and have an exit tube above.

ALFRED H. ALLEN.

MISCELLANEOUS.

Ecole Pratique des Hautes Etudes, Paris.—

The new school and the laboratories at the Sorbonne, which have been fully described in the *Journal of the Society of Arts*, were expected to be opened in the course of January. M. Milne-Edwards, Dean of the Faculty of Sciences, has recently made a report to the Academic Council of Paris upon the progress, with one important change, made in the arrangements for the new high school and laboratories. The faculty already is in possession of two physical laboratories, one for instruction under Professor Desains, in which candidates for the degree of Licentiate or Doctor may learn the management of instruments of precision, and exercise their faculties in the repetition of classical experiments relative to heat, light, electricity, magnetism, and acoustics. The rooms set apart for this purpose have been found in three old houses, close to the Sorbonne, and placed temporarily at the disposition of the faculty, and they will very shortly be opened four times a week to the pupils. The second physical laboratory is for scientific investigation, and is installed in a new building erected by the municipal authorities expressly for the purpose; this is under the direction of Professor Jamin, and was opened in the middle of last summer. The large chemical laboratory, under the direction of M. Sainte-Claire Deville, assisted by M. Schulzenberger, was to be opened early in the year. The practical study of mineralogy is to be carried on in the study of M. Delafosse, once a week at first, but afterwards twice, if necessary. There are provided two geological laboratories, both under the charge of Professor Hébert, and to be opened twice a week. The study of botany is to be divided between the Sorbonne and the Museum of Natural History at the Jardin des Plantes; the laboratory of the faculty, directed by Professor Duchartre, to be devoted to dissection, microscopic examination and analysis. A new arrangement has been made with respect to the study of

annuity, which will be divided between the Jardin des Plantes, the Collège de France, and the Sorbonne, the dissection of animals being studied at the first of these establishments. With respect to experimental physiology, a laboratory is now being arranged by M. Claude Bernard, but on a scale much too small for the purpose, but which will doubtless soon be enlarged. Lastly, says M. Edwards, the Faculty intends to complete its arrangements by the opening of a reading-room, in which the students of the new high school may consult the various scientific periodicals, and make use of the time that will necessarily elapse between the lessons; for this useful object the professors have given up their common room until a new one can be provided. It is quite evident that the Minister of Education and the learned Dean of the Faculty are determined to carry out the intentions of the government with vigour, and it would be the fault of the young men themselves who are devoted to scientific pursuits if they do not make progress, not only in educational, but in original investigation. The professors are the most celebrated in France, and the means provided are such as no university in the world offers for high scientific study. It will be strange indeed if a field so well prepared, and in such good hands, should fail to be fruitful.

Absinthe.—It appears that until 1864, the belief that there was nothing injurious in absinthe except the alcohol was general enough. In that year, however, a mad doctor named Maréchal communicated a paper to the Academy of Sciences, in which he demonstrated that the essence of wormwood was contained in the liquor called absinthe in the proportion of twenty grammes of essence to 100 litres of alcohol, and argued that this essence had a peculiarly injurious effect to the brain. In 1867 a petition was presented to the Senate, praying that the sale of absinthe might be absolutely forbidden. Nothing came of it; and now the "question of absinthe" has been once more brought forward by two physicians, MM. Magnan and Boncheran, who, for the first time, have made regular scientific experiments with the questionable stuff. The object of the experimentalists was to show what the effect of pure alcohol would be on a guinea-pig, and what the effect of absinthe. With this view they placed a guinea-pig under a glass case with a saucer full of essence of wormwood by his side, another guinea-pig being placed under another glass case with a saucer full of alcohol. The guinea-pig, who, so to say, was being "treated" with absinthe, sniffed at the fumes, and for a few moments seemed, like the absinthe drinker before mentioned, "supremely happy." Gradually, however, he became heavy and dull, and at last fell on his side, agitating his limbs convulsively, foaming at the mouth, and presenting all the signs of epilepsy. The same epileptic symptoms were manifested on the part of a cat and a rabbit, who, in a similar manner, were made to inhale the fumes of absinthe. On the other hand, the guinea-pig who was forced to get intoxicated with pure alcohol behaved like an ordinary drunkard. He became lively, then reeled about, and at last lay down, and fell into a heavy sleep.—*Pall Mall Gazette*.

Spirit from Lichens.—Mr. Stenberg has just made some experiments with a view of converting the cellulose of certain species of lichens, which are very common in Sweden, into glucose and alcohol. The species *Cladonia rangiferina* yielded the best results. Boiled for twelve hours with water containing 12½ per cent of sulphuric acid, this lichen yielded 68 per cent of glucose; fermented and distilled, the spirit obtained was found to possess a peculiar flavour of almonds (hydrocyanic acid?), but was not otherwise disagreeable; the glucose isolated and examined had a disagreeable flavour. Many lichens are poisonous; all, especially those met with in northern climes, contain a very bitter tasting principle.

Presidency of the Chemical Society.—At the of this Society, held last evening, it was announced

from the chair that Dr. Frankland, who had been nominated by the Council for election to the Presidency, had been compelled to decline that honour, owing to his present engagements rendering him unable to fulfil the duties. The subject is anxiously occupying the attention of the Council, and it is expected, before the next meeting, that a new balloting list for the election of Officers will be forwarded to the Members. The Council's list for the election of the other Members of Council stands as follows:—E. Atkinson, Ph.D., J. L. Bell, E. T. Chapman, W. Crookes, F.R.S., D. Forbes, F.R.S., D. Hanbury, F.R.S., A. Matthiessen, Ph.D., F.R.S., E. J. Mills, J. Prestwich, F.R.S., Maxwell Simpson, Ph.D., F.R.S., A. Voelcker, Ph.D., C. Greville Williams, F.R.S.

A New Element.—In our next number will be given a preliminary notice of a new element, discovered by means of spectrum analysis.

How to Preserve Sodium Untarnished.—Many teachers, particularly in our high schools, have sodium preserved in the usual way, under naphtha. But the beautiful metallic lustre is not seen under these circumstances; and if the metal is taken out and a fresh cut made, this only shows the lustre for an instant. By the following artifice the metallic appearance of sodium may be permanently exhibited:—Take two test tubes, one a little smaller than the other, so as to slip into the latter without leaving much space between the two glass walls; put some carefully cleaned sodium in the wider tube, insert the more narrow tube, having previously given a thin coating of beeswax to the upper part of this latter, then gently heat the whole on a sand bath. The sodium will fuse, and by a gentle pressure, the inner tube is pressed down, so as to force the fused metal over a large surface between the two tubes, while the air is totally excluded by the beeswax. I have kept sodium for more than six months in this way, and it is now as bright and brilliant as when first put up.—*Prof. Gustavus Hinrichs, in the Scientific American*.

Discovery of the Weight of Air.—The following extracts from a letter addressed to us by the Abbé A. Hamy will be read with interest:—It has long been asserted that, before Galileo's experiment in 1643, the weight of air had not been demonstrated. However, many learned men, both of former times and of the present century, acknowledge that Aristotle attempted to demonstrate this important fact, while, at the same time, they are unanimous in declaring that the means employed by him were inadequate to the end he wished to accomplish. The honour of the great discovery is now yielded incontestably to Galileo, and what chance I shall stand of restoring the glory of it to the philosopher appears doubtful; but my conviction is, that he has a right to it, although his opinions on the nature of gravity differ from those of modern scientific men. In "De Caelo," lib. 4, we read:—"Suo enim in loco, gravitatem habent omnia præter ignem. Signum cujus est, utrem inflatum plus ponderis quam vacuum habere." "In their own medium, all bodies except heat, have weight; the proof of which is, that a leathern bottle weighs more when filled with air than it does when empty." It was, I believe, on this experiment that Aristotle founded his assertion of the gravity of air; and the only ground on which men of science based their opinion that the merit of the discovery was not due to him was, that in endeavouring themselves to test the truth of this assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty. Such were the arguments used till the time of Galileo; then by the exact measurement of the gravity of air, the failure of Aristotle's experiment could be accounted for; and, during the present century, in all elementary books in which the barometer is mentioned the vain attempt of Aristotle to measure the real weight of air is also spoken of. But it appears to me, that the arguments used by the philosopher's enemies fail to prove what

they really intend. Of course they are right if they can demonstrate that he experimented with air at the same pressure as that of the atmosphere. But what grounds have they for such an opinion? Is it that they attribute to Aristotle what are, in reality, the failures and mistakes of his followers? We have, on the one side, the clear assertion that all bodies except heat, possess weight; and, on the other, Aristotle furnishes us with a process for the verification of this statement, which consists in weighing, not an extensible bladder, but an almost inextensible leather jar successively full and empty of air. Now what conclusion are we to arrive at from such premises? That it is impossible to succeed? Or might it not be more correct to say, that by a process the details of which have not been transmitted to us, Aristotle himself succeeded in proving the gravity of air, while the attempts of his followers to do the same resulted in failure? For myself, I believe that the great philosopher, by means of a blow-pipe, confined in his leather jar more air than it would contain at the normal pressure; and, after weighing it, first empty and then full, he found such a difference that he could positively assert the gravity of air. In these days, when *a priori* arguments are so decried, we may be allowed to dissent from a similar reasoning which would rob antiquity of its glories. Therefore, instead of saying, "Although Aristotle stated that air was heavy, he tested it by a wrong process which tended rather to prove the contrary," it would be more just to say, "Although Aristotle made use of a process, which, at first sight, appears a wrong one, yet, as we find that by the supposition of compressed air he might succeed, we conclude that he discovered the truth, since it was he who asserted the fact."

Application of the Spectrum-Microscope to Mineralogy.—At the *soirée* of the Royal Society, on Saturday last, Mr. Sorby exhibited specimens illustrating the application of the spectrum-microscope to mineralogy. He showed that the following substances could be recognised in transparent minerals or blowpipe beads by means of the characteristic absorption bands seen in the spectra, even when they were much coloured by the oxides of iron, manganese, or nickel—viz., didymium, erbium (erbium of Bunsen; Delafontaine's terbium); uranium, cobalt, chromium, copper, manganese (when it occurs as permanganic acid), a new earth, for which the name *jargonite* is proposed, and another substance, perhaps also new, but not yet sufficiently studied.

Solubility of Indigo.—M. Camille Kœchlin has discovered the curious fact of the solubility of indigo in alkaloid salts, and particularly in the acetates and chlorides of aniline, morphine, &c.

Fearful Explosion.—On Wednesday afternoon (March 10th) a terrible explosion occurred at the works of Messrs. Demuth and Co., the well-known carbolic acid manufacturers. A retort burst, and set fire to a number of barrels of naphtha. Two of the *employés* were burnt to death, and four others received very serious injuries.

Scientific Instruments.—We understand that Mr. Heisch has relinquished the proprietorship of the business at 69, Jermyn Street, carried on under the name of Murray and Heath. He is succeeded by Mr. Robert Murray, whose father established the business, and as he has for many years acted as manager for Mr. Heisch, he will, we believe, fully maintain the just reputation this firm has acquired.

Remarkable Property of Peroxide of Thallium.—Chemical processes enable teroxide to be obtained with great facility as a dark brown powder, presenting a striking resemblance to peroxide of lead. All that is necessary for this is to digest by heat some newly precipitated chloride of thallium in a solution of hypochlorite of soda, containing an excess of alkali. If a mixture of this dry teroxide and flour of sulphur is submitted to a moderate friction it ignites with explosion. When, on the contrary, to the same teroxide is added the eighth of its weight of the product vulgarly called

golden sulphur, it is observed that the ignition requires less rubbing, and takes place without explosion. We may then hope, sooner or later, for a useful pyrotechnic application of this product. Among other properties, Mr. Böttger calls attention to that which this mixture possesses of being set on fire by the faintest electric spark, far surpassing in this respect the known mixture of equal parts of chlorate of potash and black sulphuret of antimony. The author observes, by the way, that the picrate of oxide of thallium detonates also very easily under a blow.—*Jahresbericht des Physikalischen Vereins in Frankfurt*, and *Dingler's Polytechnisches Journal*.

Chrome Green.—Oxides of chrome are prepared either in the dry or wet way; obtained thus, they vary from greenish grey to a more or less deep greenish yellow. They generally have neither brilliancy nor freshness. It is possible, however, to produce green oxides of chrome which are not devoid of beauty. One of the most intelligent chemists of the commercial world, M. Casthelaz, has, conjointly with M. Leune, prepared a chrome green, which is justly styled imperial green. This colouring matter of a superior brilliancy is obtained exclusively by the wet way. The process consists in slowly precipitating chrome salts by treating them with hydrated metallic oxides, insoluble, or but slightly soluble, in water, or by hydrated metallic carbonates, or hydrated metallic sulphides, or, again, by other salts of weak acids, which easily leave their bases; the action is only produced progressively, and the oxide of chromium is precipitated in the hydrated form; the colour of the compound is magnificent, of a deep emerald green. For this preparation, it is convenient to adopt economical reagents, such as gelatinous alumina, oxide of zinc, carbonate of zinc, sulphide of zinc, &c., whose price is reasonable. The same result may be obtained by treating a chrome salt with the non-alkaline metals, which have a sufficient affinity to unite with the acid of the chrome salt and precipitate the oxide. Iron and zinc will be more particularly used, as they are cheaper. It is necessary to select from among the metals, with their oxides and salts, those which, with the acid of the chrome salt, give soluble salts, as they should be removed by washing. If recourse is had to reagents forming, with the acid of the chrome salt, insoluble salts, it is only in order to modify the colour and composition of the chrome precipitates and of the green colour thus formed. As to the magnificent imperial green colour obtained by M. Casthelaz, it possesses properties which will enable manufacturers ultimately to renounce the justly condemned and dangerous copper and arsenic greens. The use of the imperial green removes all danger from insalubrity; it is an impalpable substance, of perfect tenuity. It is believed that this property will cause the new green to be adopted for printing on stuffs, and for other purposes. The oxides of chrome known up to the present time, and generally obtained in the dry way, cannot by pulverisation, attain to the degree of fineness of the imperial green. It is expected that this substance will have great success in oil painting, coloured papers, colours, and artificial flowers, printing, lithography, perfumery, and soap manufacture, as well as in the making of glass and in the ceramic arts.—*Moniteur Scientifique*.

Alizarine.—Mr. Martin, taking advantage of Schützenberger's investigation of madder, has invented a process for transforming orange-madder, purpurine, pseudo-purpurine, and xantho-purpurine into alizarine. The several colouring matters are first dissolved in concentrated sulphuric acid; next, powdered zinc is added, and heat applied: when the reaction is completed, the mass is diluted with water; an abundant precipitate falls, which is the required dye; this after washing with water is ready for use.

The Gas Inspectorship for the City.—Mr. Charles Heisch, F.C.S., was on Thursday last elected to the office of Gas-Examiner to the City of London. This gentleman is known from his connection with the firm of Murray and Heath.

New Pocket Spectroscope.—Mr. W. Ladd, of Beak Street, Regent Street, has invented a small pocket spectroscope, which is, without exception, the most powerful for the size we have ever seen. It consists of a lens, a system of direct vision prisms and a slit. The system of prisms, containing 3 flint and 2 crown, is about $\frac{3}{4}$ of an inch long, and the whole only occupies a tube about $\frac{1}{2}$ an inch wide and $1\frac{1}{2}$ inches long. It shows the Fraunhofer lines very distinctly, and by holding a jargon in front of the slit we have been able to detect the absorption bands of jargonium. Great credit is due to Mr. Ladd for this ingenious, useful, and very convenient form of spectroscope.

Royal Institution.—The following are the probable arrangements for the Friday evening meetings after Easter:—

April 9.—W. B. Carpenter, M.D., V.P.R.S., &c.; "On the Temperature and Animal Life of the Deep Sea."

April 16.—W. Carruthers, Esq., F.L.S., of the British Museum; "On the Cryptogamic Forests of the Coal Period."

April 23.—E. B. Tylor, Esq.; "On the Survival of Savage Thought in Modern Civilisation."

April 30.—Robert H. Scott, Esq., of the Meteorological Office; "On the Work of the Meteorological Office, Past and Present."

May 7.—Capt. Moncrieff; "On the Moncrieff System of Working Artillery."

May 14.—W. H. Perkin, Esq., F.R.S.; "On the Newest Artificial Colouring Matters."

May 21.—Professor H. O. Fleeming Jenkin, F.R.S.; "On the Submersion and Recovery of Submarine Cables in deep water."

May 28.—J. Norman Lockyer, Esq., F.R.A.S., M.R.I.; "On Recent Discoveries in Solar Physics made by the Spectroscope."

June 4.—Professor Odling, F.R.S."

The Presidency of the Chemical Society.—Dr. Frankland having been nominated by the Council to the Presidency of the Society for the ensuing year, and he having felt himself obliged to decline the office,—at a subsequent meeting of Council Dr. Williamson was nominated instead, and new balloting lists were ordered to be circulated among the Fellows.

Discovery of Platinum in Scotland.—According to a brief account in the *Mining Journal*, an explorer announces that, during his investigation into the auriferous nature of Scotch quartz, he has discovered small quantities of platinum associated with the gold there existing. The platinum exists in the form of small scales resembling silver, but they are not magnetic like much of the crude platinum found in South America. In the process employed the gold was volatilised by chlorine at a bright red heat, but the platinum was left unacted on by the chlorine. Platinum is very rarely found in this country. Some ten years ago Mr. W. Mallet, of Dublin, found crude platinum in minute grains and scales associated with gold, wood, tin, &c., in the auriferous sands of some of the Wicklow rivers; about the same time it was also said to have been met with on a farm near the mouth of the river Urr, in Buittle, Kirkcudbright. Platinum has also been found near Loch Camhead.

Explosion at Paris.—On Tuesday afternoon, the 16th March, at about 3.40 p.m., a most serious accident occurred at No. 2, Place de la Sorbonne, Paris, on the left bank of the Seine, in which premises the cellars and ground floor are occupied by M. Véron Fontaine, manufacturing chemist, as a store and retail shop. During the morning of the above day, there had been delivered at that place a parcel containing 28 kilogrammes of picrate of potash, intended to be forwarded to the experiment submarine torpedo manufacturing establishment, situated on the Isle d'Aix, on the coast of the Département de la Charente Inférieure, there to be employed in ex-

periments. It is not precisely known what caused this material to explode, but it is surmised to be due to carelessness. The violence of the explosion was increased by the fact that a portion of the large quantity of ether and alcohol stored in glass carboys in the cellars of the premises on their vapour becoming mixed with air, in consequence of the breaking of the carboys by the shock of the explosion, partly exploded, and, becoming inflamed, set the whole building in a blaze. It is authoritatively denied that any picrate of potash was made on the premises; and that neither nitroglycerine nor any fulminates, nor gun-cotton, nor gun-powder were ever in the place at all. The manufactory is situated in the remote outskirts of Paris, in a lonely and secluded spot.

Aniline Grey.—The following recipe has been published by M. Bloch, to produce an aniline grey colour:—1 kilo. of aniline at 190°, and 5 kilos. of arsenic acid in a liquid form at 75°, are taken and heated on the open fire in a cauldron, care being taken to maintain the heat at the boiling point, till the substance thickens and rises, when the operation is terminated and the vessel is removed. The substance obtained presents a blackish appearance; it is thick, and insoluble in water. In order to purify the product, about 20 litres of water, and 1 kilo. of muriatic acid are taken and boiled with steam for half an hour, after which the mass is filtered. The matter which is deposited on the filter is collected, washed with boiling water, and operated upon a third time by a small quantity of carbonate of soda in solution, so as completely to neutralize the acid. Finally, the collected matter is dried, and gives a fine black powder. The solution of this product is made by treating it with alcohol, with an addition of 10 per cent of sulphuric acid. Nothing now remains to be done but to filter it. With this liquor, magnificent greys of all shades are dyed, by submitting its mordant to the dyeing bath. For the dyeing and the printing of this grey colour, the matter must first be passed through a water bath, strongly acidulated with sulphuric acid. A skein of silk or wool is dyed by five drops of this liquor.—*Moniteur Scientifique*.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "CHEMICAL NEWS."]

Comptes Rendus. December 7, 1868.

SECCHI: "On some Peculiarities of the Spectra of Solar Protuberances."—A. DAMOUR: "Analysis of Adamine from Cape Garonne, Var."—A. RICHE: "Researches on the Alloys of Copper and Tin."—BERTHELOT: "On the Combination of Free Nitrogen with Acetylene, and on the Direct Synthesis of Hydrocyanic Acid."—H. MOSCETTI: "Note on the Lunar Protuberances observed by De Ordry at Aden during the Eclipse of the Sun of August 13, 1868."

December 14, 1868.

MOUCHOT: "On the Application of Solar Heat as a Substitute for Fuel in Certain Countries."—WARREN DE LA RUE: "Observations on Pincus's Claim to the Invention of a Constant Voltaic Battery described by the Author and H. Müller."—BERTHELOT: "On the Formation of Acetylene, and on some other Phenomena of the Action of the Electric Spark on Marsh Gas."—C. FRIEDEL: "On a new Mode of Formation of Acetylenebenzene, and on the Homologues of Acetylene."—L. THOOST and P. HAUTEFEUILLE: "On Some Properties of Cyanic Acid."—FILHOUL and MELLIER: "On the Action of Iodine on Certain Sulphides."

Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften zu München. (Mathematisch-physikalische Classe.)

November 9, 1868.

BUCHNER: "On the Formation of Sulphide of Arsenic in the Corps of a Person Poisoned by Arsenious Acid."—C. VOIT: "On the Formation of Fat in the Animal Body."

December 7, 1868.

F. VON KOBELL: "On Typical and Empirical Formulae in Mineralogy."—BUCHNER: "On the Composition of the Blood in Cases of Poisoning by Prussic Acid."

Annalen der Chemie und Pharmacie. November, 1868.

C. REIDER: "On the Behaviour of Oxysulphide of Carbon towards an Alcoholic Solution of Potash."—J. DUVEY: "On Pimaric Acid and its Derivatives."—E. G. STRAUSS: "On the Composition of Copaliba Balsam."—O. VEIL: "On the Transformation of Fatty Acids into the Alcohols of the Parallel Series."—E. LOSSEN: "On the Oxidation of Acetic Acid to Oxalic Acid."—W. HEINTZ: "On Glycocolamide and Diglycocolamide Diamide."—J. WISLIZEN: "On the Brominated Addition Product of Pyroacetic Acid."—J. DEMBEY: "On the Transformation of Chlorobenzoic Acid into Oxysulphide Acid."—N. VON DER BRUGEN: "On the Diethyl Ether of a Dilactic Acid."—KRAUT: "On Atropine."—On Cinamic Acid and its Isomer Atropic Acid."—E. LINDEMANN: "On the Reduction of Acetic Anhydride to Ethylic Alcohol."—On the Synthesis of Normal Primary Propylic Alcohol of Fermentation."—A. SIERSCH: "Researches on the Transformation of Isopropylic Alcohol into Butylic Alcohol."—On Isopropylamine and Diisopropylamine."

Journal für Praktische Chemie. November, 1868.

A. H. VAN ARKUM: "On the Essential Oil and the Poisonous Principle of the Root of the *Cicuta virosa*."—W. L. CLASEN: "On the Influence of Potash Manure on Beetroot."

December, 1868.

A. REMPLER: "A Volumetric Method of Estimating Copper."—F. VON KOHLL: "On the Crystalline Spessartin of Aeschaffenburg, and on a Dense Variety from Pfaffsch."—On a Specimen of Almandine from Northern Columbia."—C. F. SCHONBEIN: "On the Occurrence of Active Oxygen in Organic Substances."—On the Transformation of Nitrate into Nitrite by Ferment and other Organic Tissues."—On some Chemical Properties of the Seeds of Plants."—On the Most Delicate Test for Peroxide of Hydrogen."—On the Behaviour of Extract of Malt and Blood Corpuscles towards the Free Oxygen contained in Camphene and in Fatty Oils."—On the Behaviour of Aldehyde towards Ordinary Oxygen."—On the Behaviour of certain Organic Matters towards Ozone."

PATENTS.

Communicated by MR. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3965. A. G. Gazalat, Rue Gallon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—Petition recorded December 30, 1868.
337. L. Wray, Kamsgate, Kent, "An improved process for carbonising and hardening wrought-iron."—February 3, 1869.
355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.
419. P. Jansen, Leith, Scotland, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Book, Copenhagen, Denmark.—February 10, 1869.
434. H. Edwards, Staple Inn, Holborn, "An improved preserved food."—February 12, 1869.
442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.
460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jun., Quebec, Canada.—February 15, 1869.
469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."—February 17, 1869.
473. O. E. Brooman, Fleet Street, London, "Improvements in treating the waste of wool, silk, horn, and other nitrogenised animal matters to be used as manure."—A communication from P. Pichelin, Orleans, France.—February 17, 1869.
488. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved method of obtaining benzole and its homologous substances from coal gas."—A communication from H. Caro, A. Clemm, C. Clemm, and F. Engelhorn, Mannheim, Baden.—February 17, 1869.
510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating, and otherwise operating upon minerals and other substances."—Petition recorded February 10, 1869.
533. T. H. Simmonds, Great Mitchell Street, in the county of Middlesex, and E. B. Moreland, Bartholomew Close, London, "An improved compound for glazing or 'finishing' linen-faced paper used in the manufacture of collars and cuffs, and for other purposes."—February 20, 1869.
546. T. S. Blair, Pittsburg, Penn., U.S.A., "Improvements in the manufacture of iron and steel."—February 22, 1869.
548. B. J. B. Mills, Southampton Buildings, Middlesex, "Improvements in the manufacture of artificial stone."—A communication from W. Monroe, Boston, Mass., U.S.A.—February 22, 1869.
565. S. Holroyd, Newton Heath, Manchester, "Improvements in the recovery of substances used in the purification of gas for illumination, and of waste products arising therefrom."

566. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the construction and arrangement of machinery, apparatus, and buildings employed in or for the manufacture or production of cast-steel and malleable iron from pig or other carburet of iron."—February 23, 1869.

574. J. J. Vaughan, Mitre Lane, near Kensal Green, Middlesex, "Improvements in treating, converting, and utilising the metallic salts and sulphuric acid contained in or derived from the residual or waste liquors of tinned plate works and petroleum and paraffin refineries."—February 24, 1869.

586. W. E. Newton, Chancery Lane, "Improvements in furnaces and apparatus for oxidising and desulphurising iron and other ores."—A communication from W. H. Reinohl, Pine Grove, Penn., U.S.A.—February 25, 1869.

597. J. A. F. Suter, Hereford, and T. G. Hinde, Fownhope, near Hereford, "Improvements in furnaces and in the combustion of fuel for melting steel, and for other purposes where high temperatures are required."

598. G. J. Hinde, Wolverhampton, "Improvements in coating iron or steel with copper or brass, or other alloys of copper."

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

621. J. Rust, Lambeth, Surrey, "A new or improved composition specially applicable for use for pictorial and decorative purposes."

632. J. G. Willans, St. Stephen's Crescent, Paddington, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—March 1, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2, 1869.

641. F. A. Gatty, Accrington, Lancashire, "A certain process or processes for obtaining the colouring matter of madder and another useful product."—March 3, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

670. W. E. Gedge, Wellington Street, Strand, Middlesex, "An improved process and improved apparatus, having for object to preserve from oxidation iron ships and metallic surfaces, or those of copper or iron with which wooden ships are sheathed; also applicable for testing the qualities and the homogeneity of metals."—A communication from E. Demance and G. J. Berlin, Faubourg St. Martin, Paris.—Petition recorded March 5, 1869.

713. H. A. Bonneville, Chaussée d'Antin, Paris, "A new sort of porcelain, and a new and improved process for manufacturing the same."—A communication from A. Vidal, Rue St. Sauveur, Paris.

NOTICES TO PROCEED.

3154. W. E. Gedge, Wellington Street, Strand, "Improvements in the manufacture or preparation of artificial fuel."—A communication from C. de Lin, and A. C. Dalma, Rue Blondel, Paris.—Petition recorded October 15, 1868.

3177. E. T. Hughes, Chancery Lane, "An improved adhesive substance."—A communication from J. Totin and A. Totin, Montreuil, France.—October 17, 1868.

3203. G. Chapman, Glasgow, N.B., "Improvements in treating sewage in order to obtain valuable products therefrom."—October 20, 1868.

3248. J. Baggs, High Holborn, "Improvements in smelting, carburising, and purifying iron."

3250. J. Spratt, High Holborn, "Improved preparations of food for horses, cattle, game, poultry, and other domestic animals, such preparations being capable of admixture with compounds for the production of a medicated food for man."—October 24, 1868.

275. N. C. Szerelmey, Belgrave Road, Piccadilly, "Improvements in making tarpaulin in different colours, and in treating sail-cloth and other fabrics to preserve them from rapid destruction by the sea air and other corroding influences."—January 29, 1869.

3226. C. Macmillan, Sunderland, "Improvements in protecting iron ships and other submerged surfaces from corrosion and marine growths, and in compositions to be so employed."—Petition recorded October 21, 1868.

3256. A. Giraud, Gray's Inn Road, Middlesex, "Improvements in separating silver from argentiferous lead, in purifying lead, and in apparatus for the same."—October 24, 1868.

3267. P. M. Crane, Manchester, "An improved compound or size to be used in sizing and dressing cotton yarns or cotton warps."—October 26, 1868.

3309. W. H. Liddell, Edinburgh, "Improvements in treating all kinds of pig skins in the processes of preparation, tanning, currying, enamelling, and japanning, and in utilising the products."

3315. E. Oxland, Plymouth, "Improvements in the treatment of ores and minerals for the extraction of tin."—October 29, 1868.

3352. M. Sautter, Rue de la Chaussée d'Antin, Paris, "Improvements in preparing and preserving vegetable and animal substances."—A communication from W. O. Giles, New York, U.S.A.—November 4, 1868.

3361. W. S. Jackson, Walworth, Surrey, "An improved method of treating bones and the products obtained therefrom, so as to render them available for various useful purposes."—December 10, 1868.

3370. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in puddling and other furnaces employed in the manufacture of wrought-iron and steel."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 6, 1869.

3386. W. R. Lake, Southampton Buildings, Chancery Lane, "Improved lining for puddling and other furnaces."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 6, 1869.

NOTES AND QUERIES.

Substitute for White Lead.—Mr. Sace has called attention to the fact that tincture of baryta forms an excellent white paint, which has as good a tone and depth as white lead, and has the advantage above this of not becoming blackened on exposure to the atmosphere. Zinc white, which was tried as a substitute for white lead, has failed through wanting body.

Pigment Colours.—Among the very small number of books published on the subject of the manufacture of pigment colours the most recent is that edited by J. G. Gentile, published at Brunswick, by Vieweg and Son, under the title, "Lehrbuch der Farben Fabrikation; &c." 1860, or later. This is a most useful and complete treatise on this subject, and full of sound practical information.

Removing Carbonic Acid Gas from Wells.—A correspondent of the *Scientific American* gives an account of an ingeniously extemporised apparatus for removing carbonic acid from wells. It was simply an opened out and extended umbrella let down and rapidly hauled up a number of times in succession. The effect was to remove the gas in a few minutes from a well so foul as to instantly extinguish a candle previous to the use of the umbrella.

Coal Ashes.—A series of experiments conducted at the Museum of Natural History, Paris, during the past year by Professor Naudin, has resulted in the conclusion that coal ashes act neither as a manure nor even as earth of the most infertile quality. It is certain, however, that upon a heavy clay they act as disintegrators, an effect which cannot very well be only mechanical, as a very small amount of coal ashes is sufficient to destroy the adhesiveness of a large amount of clay.—*Engineer.*

Products of an Alkali Work.—What is the yellow colouring matter in good strong sulphate of soda? What is the red colouring matter in red balls? What is the red colouring matter in red liquor? What is the red colouring matter in ordinary soda ash? In making a full analysis of soda ash ought the soda which is combined with the silica to be deducted from the total available soda? or, in other words, is the total available soda affected by the presence of silicate of soda?—X.

Dyes from Ochella Weed: Ochella.—"Chromo" is referred to "Tre's Dictionary of Arts, Manufactures, and Mines," 6th edition (articles: Litmus, Lichen, Ochella Weed, Orcin); also to "Watts's Dictionary of Chemistry," vol. iv. (articles: Orcin, Ochell, and others); and lastly, for a full account of this matter to "Theorie und Praxis der Gewerbe, Hand und Lehrbuch der Technologie," von Dr. John E. Wagner, vol. iv., page 470 and following. All these works may be inspected at the library of the Commissioner of Patents.

Alloy for Silver Coinage.—The authorities of the Mint of France have been experimenting for replacing copper either partially or entirely as an alloy for the silver coinage of that country. The advantages are said to be that the metal (alloy) is more homogeneous, has at least a fine white lustre, and possesses a clear ring and considerable elasticity. When toughened by continued or repeated rolling it annealed by simple heating, it is less liable to be blackened by the sulphuretted hydrogen. A mixture containing 835 parts of silver, 93 of copper, and 72 of zinc is recommended.—*Engineer.*

Lute for Corks.—Professor Hirzel, of Leipzig, recommends as a lute for covering corks of vessels containing volatile substances (as for instance, benzine, light petroleum oil, and essential oils), a mixture made up of finely ground litharge, and concentrated glycerine; this is made into a paste, and the corks or bungs are covered with it; this mixture hardens very rapidly, is insoluble in, and not at all acted upon by, the said liquids, and is inexpensive, inasmuch as even coarse glycerine, provided it is concentrated, answers the purpose.—*Dingl. Polyt. Journal.*

Chemical Nomenclature.—It strikes me that the following rule would be desirable in chemical nomenclature, at least as to organic compounds:—That "oxide of" (or chloride, &c.) should always be used where oxygen is added to the body, and "iodide" (&c.) after the name when a substitution takes place only, thus:—The true constitution would be expressed by the name (say of CH₃I) whether called "iodide of methyl," or "methane iodide"; but it should never be called "methyl iodide," to avoid confusion. So far as supposed radicals do not exist, unless in composition, attention to this rule would do away with an unnecessary assumption, and make the names more expressive of actual knowledge.—H. H.

Glycerine: its Uses and Abuses.—Tubs and pails saturated with glycerine will not shrink and dry up, the hoops will not fall off, and there will be no necessity for keeping these articles soaked. Butter-tubs will keep fresh and sweet, and can be used a second time. Leather treated with it also remains moist, and is not liable to crack and break. It is used for the extraction of perfume from rose leaves and other scented materials; employed to preserve animal matter from decay, and therefore also to prevent many articles of food from undergoing decomposition; mixed with its own bulk of water it is used in gas-meters, owing to its requiring intense cold to freeze; the works of delicate chronometers, clocks, and watches are lubricated with it. It is largely used in pharmacy to keep moist and preserve extracts, pills, and other preparations; it is used in dyeing some of our beautiful organic colours; in chemistry it is applied to prevent the precipitation of the heavy metals by the alkalis, and is thus a reagent in analysis; it is used in brewing beer for making an extract of malt, as also in the manufacture of liqueurs (cordials); it is applied to the preservation, and no doubt to more than that, viz., the making of wines and champagne. Since glycerine can be fermented into alcohol with chalk and cheese, it may in future become a source of alcohol and acetic acid. Lastly, glycerine is the source of nitroglycerine, a most dangerous explosive substance, and of dynamite, which is simply nitroglycerine mixed with sand, and is much less dan-

gerous than nitroglycerine, and nearly as destructive in its effects, as it contains 75 per cent of nitroglycerine.—*Abbreviated from the Scientific American.*

Swiss Concentrated Milk.—Results of analyses of concentrated milk, so-called extract of milk, prepared at Cham, near Zug, Switzerland. According to Dr. Bolley, 100 parts of the concentrated substance contain:—

Butter (fatty matter).....	8.67
Caseine and lacto-proteine	13.67
Sugar of milk.....	10.82
Cane sugar (added previous to beginning the operation of concentration).....	40.48
Mineral matter.....	2.73
Water.....	24.73

100.00

If we deduct the quantity of water and that of the cane sugar, there remains 35.39 per cent for the constituents of really dry milk. Since the dry matter of good cow's milk contains, according to an average of four analyses made at Cham by Dr. Bolley,

Butter (fatty matter).....	3.95
Proteine substances.....	4.30
Sugar of milk.....	4.60
Mineral matter.....	0.72

it follows that 26.1 grammes of this milk contain as much dry solid matter as 100 grammes of the concentrated milk.—*Abstracted from Gewerbeblatt, &c., für Bayern.*

Guano of Meillonos contains, according to Robierre's analyses, 33 per cent of phosphoric acid, equal to 71.5 per cent of tribasic phosphate of lime.

Silicated Hydrogen.—Mr. Freidel has just discovered that this gas is entirely decomposed by the electric spark, giving rise in the audiometer to a shower of amorphous silicium of a brown colour.

Fibrin of Blood.—According to Messrs. Béchamp and Etor, the substance denominated fibrin of blood is only a kind of membrane formed by the microzymas of the blood associated or accompanied by a substance secreted by them by means of the albumenoid substances of the blood.

Aniline Black.—"New Berne" is referred for this matter to the *CHEMICAL NEWS*, August, 1856 (*Eng. Ed.*), p. 59, and to the volumes of Eisner's *Chemisch Technische Mittheilungen*, published annually since 1846, all of which may be inspected at the free library of the Commissioners of Patents.

Preservation of Hydriodic Acid.—This acid is kept and properly preserved in a white state in the presence of turnings of copper; the iodide of copper which is slowly formed is not dissolved by the acid; hydriodic acid which has become brown-colored will be restored to its pure color when shaken up with copper turnings.—*Deutsche Industri Zeitung.*

Aniline Black for Cotton.—"New Berne" enquires in the "Notes and Queries" whether there is an aniline black for cotton. There is an aniline salt used in this district by many calico-printers which, treated with an oxidising paste made on purpose for it, produces a black considered the best out. If your correspondent will apply to S 48, Post Office, Manchester, he can learn all about it.

Atomic Weight of Lanthanum.—M. Zschiesche has prepared sulphate of lanthanum of such a purity that a thickness of 17 centimetres of a saturated solution gave no trace of the absorption bands of didymium. Working on this, he has found the atomic weight of lanthanum to be, from a mean of six experiments, 45.99. The extremes were 44.72 and 45.625.—*Journ. de Chim. Prat.*

Picric Acid of Quinine has been tried, according to the *Revue Maritime et Coloniale*, in the French Navy and some French settlements in Asia and Africa where a peculiar kind of ague was prevalent, but it has not been found to answer at all well, as it affects the digestive organs; besides this picric acid, although intensely bitter to the taste, is now considered not to possess any medicinal properties which would render it peculiarly valuable; its internal use tinges the skin yellow.

Action of Aqua Regia on Sulphur.—Mr. Lefort has studied the action of aqua regia upon sulphur and sulphur ores; he finds that at first there is a chloride of sulphur formed by the disengaged chlorine, but soon after this compound is again destroyed by the action of the nitric acid, and chlorine is set free, while sulphuric acid is formed. Lefort finds that the best proportion of the mixed acids most suitable for the rapid oxidation of sulphur is 1 part of hydrochloric and 3 of nitric acids, precisely the reversed proportion as used for ordinary aqua regia.

Mr. Sorby's Researches on Diamonds.—Mr. Sorby finds that the supposed cavities in diamonds described by Brewster are in reality enclosed crystals, and the conclusion arrived at from the consideration of the whole structure of the diamond is not opposed to its having been formed at high temperature. The crystals enclosed in diamonds are frequently seen to be surrounded by a series of fine radiating cracks, which are proved to have been the result of the contraction suffered by the diamond in solidifying over the enclosed crystal, and this explanation has been artificially verified by examining crystals formed in fused globules of borax glass, cooled slowly, when the same phenomena are seen.

Assay of Gold Quartz.—First let the rock containing gold be roasted at a red heat, as is practised with regard to flints intended for pottery-ware manufacture; this roasting renders it easy to break the

rock afterwards into small pieces. In this state the rock should be placed in a large earthenware (fire-clay) tube fixed in a furnace in a manner similar to the large fire-clay retorts used in the manufacture of gas (double retorts), open at both ends and projecting beyond the furnace on each end; the heat in the interior of the tube should be bright cherry-red. If, under these circumstances, a current of chlorine gas be passed through the retort, the gold contained in the rock will combine at the high temperature with the chlorine, and become volatile therewith, whereas at the place where the heat of the tube or retort is less high, the chloride of gold will become again decomposed and gold deposited.

Will Steam Ignite Combustible Substances?—This curious question is discussed in a recent number of the *Scientific American*. It is urged that as the heat generated by a hydrocarbon in combination with a combustible fibre will produce combustion, and as a fibrous material saturated with oil will, if exposed to the sun's rays, burst into flame, it follows that a greater degree of heat, whether produced by steam or any other agency, may produce like results. After mentioning the inflammable condition acquired by wood through which a steam-pipe has been passed, it is remarked that every engineer of some experience and close observation knows that it is possible to ignite combustible or inflammable substances by the direct impact of steam. Cases are on record where dry wood was ignited by escaping steam, and, as an experiment, oil-saturated cotton waste and dry pine wood have been lighted by the steam from a boiler at a distance of 12 feet, the pressure of the steam being at the time only 95 lbs., and the temperature of the steam, inside the boiler, not at 12 feet distance thereof, 335° F.; the material burst into flame in a few minutes. I witnessed many years ago a case where a quantity of rancine, i.e., madder root not yet ground, took fire simply by being heated up to about 210° F. by means of the waste exhaust steam from a small high-pressure steam-engine being made to pass through a series of pipes, above which the rancine was placed on an iron grating in a layer some 4 inches in thickness.—Dr. A. A.

Carbolic Paper.—Pugliari, an Italian chemist, has invented a kind of paper wherein carbolic acid is so thoroughly incorporated that the paper, when used to pack animal substances therein, preserves the same in a fresh state without salt or any curing whatever.

Odylite Force.—In the obituary notice of Baron von Reichenbach, in No. 480, vol. xix. (*Am. Repr.*, March, 1869, page 162), of the *CHEMICAL NEWS*. It is stated he has investigated the supposed new *odylite force*. Can any of your subscribers give a list of his writings on this subject, or those of any other author who has written on the same subject in French, German, or English?

On some New Products Obtained from American Petroleum.—Lefebvre has found therein a substance which boils at 23° C., and the composition of which is expressed by C_6H_4 ; the specific gravity of this liquid is 0.613, the vapor density is 1.60; with hydrochloric acid it forms propyl chlorhydric ether. The residue of the rectification of these kinds of petroleum yielded hydride of butyl, C_4H_{10} , which boils at 0° C., and has a specific gravity of 0.624.

Vanilline.—Mr. Gobley has instituted researches concerning the odoriferous principle of vanilla. He found a substance therein which crystallises in long colourless needles; to the taste this substance was aromatic and hot; it does not affect litmus paper, fuses at 70° C., volatilises at 150° C., is nearly insoluble in cold, somewhat more soluble in hot water, and very soluble in alcohol, ether, and volatile as well as fatty oils. Its composition is expressed by $C_{10}H_{10}O_4$. Gobley calls it *vanilline*.

Action of Heat on Tartaric Acid.—Dr. Sacc has heated tartaric acid in a large glass retort, taking care that not a particle of the acid was carried over mechanically during the process of distillation. He obtained in the receiver a very acid, nearly colourless, very mobile liquid, which turned out to be acetic acid; there was left in the retort a carbonaceous mass, while carbonic acid was given off. According to the author, it is possible that tartaric acid is a double acid made up of oxalic and acetic acids.

Hydroxyl.—Would you be good enough to inform me what is the nature and properties of "hydroxyl"? This substance is one with which candidates in the coming examination of the Department of Science and Art are expected to be acquainted with. I for one never heard of it before, and a search I have made to find it even mentioned in either Watts's "Dictionary" or in Miller's and Roscoe's books has been unsuccessful.

[Hydroxyl is another name for peroxide of hydrogen. It is supposed to act as a compound radical, equivalent to the simple radical chlorine.—Ed. C. N.]

Drying Green Wood.—A new method for drying green wood in a short time consists in boiling it for some hours in water, then leaving it to cool, next boiling it in an aqueous solution of borax, whereby the insoluble albumen of the wood is rendered soluble and escapes from its pores. The wood is then dried in chambers heated by steam, and left therein for three days. Wood so treated is more compact than it would be by ten years' exposure to air; it is far more secure against decay, does not shrink nor warp, and is more easily polished on account of its having obtained by this treatment a more dense structure.—*Builder*.

On the Soluble Hydrates of Carbon met with in Fruits.—Commalle asserts that the saccharine materials met with ready formed in fruits, and also the substances which are capable of becoming saccharine matter, are far more varied than is usually supposed; in melons and parsnips Commalle, while testing the juice of these fruits at diverse periods of maturity and development, found sometimes saccharine substances capable of left-handed polarisation, sometimes substances endowed with right-handed polarisation, sometimes he found levulose, and at other times substances as yet either entirely unknown or imperfectly described; he comes to the conclusion that the various substances met with in fruits are always in a state of change.

Positive or Negative?—Will one of your numerous readers be so

kind as to inform me which is the *positive* and which the *negative* end of a voltaic battery? Miller, in vol. i., p. 577, says the zincode is the same as the anode, or positive pole, and that here we have O, Cl, and acids, which therefore must be electro-negatives. The platinum is said to be the same as the cathode or negative pole, and that here we get H, metals, and the alkalies (electro-positives). In Lardner's "Handbook of Electricity," edited by Foster, p. 104, the zinc end is marked negative, and the copper positive. Ganot, in his "Physique," 7th edition, 1857, p. 596, says, "Le pôle positif est toujours à l'extrémité vers laquelle les zinc de chaque couple sont tournés; et le pôle négatif à l'extrémité vers laquelle sont tournés tous les cuivres." All this is sufficiently puzzling, but on referring to an old edition of Golding Bird (1854), p. 341, he says that both O and H, together with N, S, P, Cl, etc., are electro-negative elements. If O is given out at one end, and H at the other, how can they both be electro-negative? Again, he says (p. 344), "the positive current passes from the copper to the zinc plate." Other writers say exactly the reverse. If any one would put this matter in a clear light, the medical students of this country ought to vote him (I don't say they will) a piece of plate (not electro).—A MEDICAL STUDENT.

On Some of the Changes Pitcoal Undergoes when Heated.—Dr. E. Richter records some curious phenomena concerning coal when submitted for some time to heat. He took coal, reduced it to powder, and dried it in the cold over sulphuric acid, until it ceased to lose weight; the coal was then heated to a temperature of from 180° to 200° C.; after having been submitted to this heat, even for a short time, an increase of weight was found to have taken place; this increase in weight was observed to go on until, after twenty hours, it reached its maximum, since, if the heating were continued after that time, a decrease of weight was observed. The coal, the weight of which had increased, was found to differ from the coal originally taken in the following particulars:—Its outward physical appearance is not perceptibly altered, but it has increased in specific gravity, its chemical composition is changed, it behaves in a peculiar manner when coked in a covered crucible, and it has obtained increased faculty of attracting water from the air. Even when the coal originally taken and dried under a desiccator belonged to the caking coals, after heating it does not cake any longer, but behaves as a non-caking coal when ignited in a close crucible. When submitted to destructive distillation, the first product which comes over into the receiver shows, in a very remarkable degree, a reddening of blue litmus paper, while no tar is produced at all. When 2 grammes of the previously heated (to 180° or 200°) coal were left exposed on a watch glass, even to a rather dry atmosphere, it was found that, after fourteen and thirty-six hours' exposure, the increase in weight was respectively 3.1 per cent and 4.8 per cent; when exposed in a drying stove to a temperature of 105° C. for a quarter of an hour, the original weight was restored again. As regards the chemical composition, it was observed that the previously heated coal differed from that dried under the desiccator by a loss of carbon and hydrogen and an increase of oxygen and nitrogen.—*Abridged from the Deutsche Industrie Zeitung*.

Preservation of Meat.—According to Marchal de Calvi, meat may be kept in a fresh state and without risk of putrefaction by being placed for some fifteen or twenty minutes under a bell jar wherein sulphur has been suffered to burn.

Action of Heat on Zircons.—Henneberg (*Chemical Gazette*, 1847, vol. v., p. 96) noticed that zircons increased in density by being heated, the change being accompanied by phosphorescence and a permanent lightening of color. Previous to ignition the crystals possessed the specific gravity 4.615, and after ignition 4.710.

Separation of Zinc and Copper.—M. G. O. Wittstein writes, in his *Revue Trimestre*, that for the separation of zinc from copper the treatment of the sulphides with dilute sulphuric acid may be applied, being the method pointed out by Dr. Hofmann for separating cadmium from copper.

Aniline Green.—It is stated that Dr. Hofmann and Mr. Charles Girard at Berlin have successfully obtained pure aniline green, which green is only distinguished from the aniline violet by the elements of iodide of methyl, so that the violet can be readily converted into the green, and the green into the violet.—*Moniteur Scientifique*.

Gardenia Grandiflora.—Can any of your correspondents inform me through the medium of Notes and Queries where a small quantity of the seed of *Gardenia grandiflora* could be procured for experimental purposes? What would be the best means of bringing into notice a method for improving low, greenish qualities of indigo?—CHROMO.

Oil from the Curcas Purgans has been investigated by Da Silva, who states that it furnished him a small quantity of octylic alcohol, and that it yields as much as 6.10 per cent of nitrogen. The *Curcas purgans* is an Euphorbiaceous plant, which furnishes a kind of castor oil; it grows in many parts of Africa, and especially in the Cape de Verd Islands.

Desulphurising Coal.—Messrs. Grandier and Marcel have invented an apparatus for decomposing, by means of the combined agency of heat and compressed air, or heat and high pressure steam, the sulphurets of iron contained in ores, coal, and also coke. The sulphur oxidised completely, without affecting the good qualities of coal or other material submitted to the action of this process.

Influence of Pressure on Chemical Action.—According to experiments and observations made by Cailletet, the strongest acids, properly mixed with water, cease to exercise any solvent action, or to disengage hydrogen gas from iron, tin, zinc, aluminium, sulphide of iron (sulphuretted hydrogen gas), when a strong pressure is made to exercise its influence within the vessel wherein the chemical action is taking place.

New Freezing Mixture.—I have made an observation which appears to me of considerable interest. I dissolved 10 grammes of crystallised carbonate of soda in 100 grammes of water, and crystallised it into a pasty mass.

AMERICAN SUPPLEMENT.

New York, May, 1869.

Spirit Photographs.

THE so-called spirit or ghost photographs have been known from the beginning of photography. As an accident they have occurred to every photographer, and any person of very ordinary capacity could invent some of the many ways of producing them. In these pictures as lately made, beside the likeness of the sitter appears a misty, half-formed image of another person, and generally in some awkward or extraordinary attitude; this second image is intended to represent a ghost or spirit. Spirit photographs are seldom artistic, and they elicit no reasonable curiosity except as to how they are produced.

Among the photographers who have made the spirit photographs is Wm. H. Mumler of this city. Spirit photography has been his specialty for the past seven or eight years, and he is probably better skilled in the art than any other person. The pictures are a little more troublesome to make than other photographs, and he has very properly charged a higher price for them. But he represents that they are produced by supernatural agency beyond his control, and that they represent genuine spirits. The art is, therefore, in his hands a low sort of swindle akin to the spirit-rapping, table-tipping, and fortune-telling trickery, and perhaps, as is the fashion, ought to be ignored by the executors of the law. The profits from such business are small, and perhaps the dupes of such shallow artifices deserve to be swindled. But some estimable gentlemen, believing that Mumler's offence merited conspicuous punishment, caused his arrest; he was certainly amenable to the law, and the case before the court appeared a very simple one in the beginning: Did Mumler make the representations as alleged, and did he obtain money thereby? were the only questions of fact to be determined. These questions might have been answered in a few minutes, and the case have been ended; but affairs took a different turn, and the trial hangs on for about two weeks.

Mumler has the assurance to reply to the court that his spirit pretences are true, and not false; that the pictures are genuine spirit pictures; that spiritual manifestations are a fact, and the learned Judge (Dowling) allows the trial to proceed on the issue of supernaturalism and spiritualism. Mumler has no difficulty among his multitude of dupes to find enough to swear to the genuine spirituality of his pictures. One of them, an ex-Judge, testifies: "I did not examine the process, as I am not an expert in photography, but am confident the likenesses are really those of spirits; have frequently seen spirits with my own eyes," &c. On the other hand, it is shown by several practical photographers that pictures similar to Mumler's may be produced by various simple mechanical appliances. The evidence of the prosecution was not well managed, and lacked in completeness and system. In short, at the conclusion of the testimony Mumler has much more of the public sympathy than at the beginning, and the chances are good that he will escape unpunished. The case is now (April 28th) adjourned for the lawyers' speeches to May 3d.

Spiritual photography implies spiritual chemistry, and that chemical action may take place in the absence of the conditions of chemical action. The spiritual

manifestations as interpreted by spiritualists involve the taking away of the fundamental facts and data of science. If the supernatural is allowed as a defence to a criminal charge, where is to be the end of such a practice? There is no crime that may not be committed in the name of spiritualism.

Phosphoric Acid in Soils and in Iron Ores.

THE following paragraphs are extracted from a paper by Dr. Paul Schweitzer, of the School of Mines of Columbia College, entitled: "On Tribasic Phosphoric Acid, its History, its Modes of Separation from Sesquioxides, principally from Sesquioxide of Iron, and its Estimation." The paper is of great value to analytical chemists, and we regret that our space is so narrow that we are unable to reproduce the whole of it in the SUPPLEMENT; it will appear entire in the forthcoming number of the "Annals of the Lyceum of Natural History."

"This tenacity of the sesquioxide of iron to retain alkaline salts, especially salts of potassa and ammonia, connected with the same degree of affinity it has for phosphoric acid, seems to me of great moment in the process of nourishment of plants. The hydrated sesquioxide of iron, which to a greater or less extent is never wanting in any soil, is like the humus, the upper crust of the land, a holder of those mineral constituents on the presence of which in the soil the existence of vegetable life is dependent. Yes; I may say, considering the powers of the sesquioxide of iron (as well as alumina) to condense in its pores gases like carbonic acid and ammonia—gases that are the daily food of plants—it is, perhaps, possible to demonstrate the fertility of a soil as depending upon a certain amount of sesquioxide of iron. Certain it is that the latter substance, changing continually, converts, by its own oxidation and reduction, the complicated carboniferous compounds with which nature and human foresight supply the soil into more simple forms, that alone are adapted to the maintenance of vegetable life; and after having converted them into those compounds, retains them, and disposes of them to the plants under the influence of the stronger, living powers of assimilation, by means, perhaps, of the hydrated water which always, even after the long-continued heat of a hot summer, is to be found in sesquioxide of iron, and which, if I may say so, serves as a canal of transportation of the inflexible motionless of the dead mineral into the plastic moving—into the living protoplasm—of plant and animal.

* * * * *

"As this finishes my actual work as regards the separation of phosphoric acid from iron, I may be allowed to give my views as to the state in which this acid occurs in iron ores, and submit to your consideration some points which may finally lead us to succeed in preventing it from entering to a larger extent into the composition of metallic iron.

"Phosphorus is always contained in iron ores as phosphoric acid. I believe this to be the case even in bog ores, the only ores in which we might question this statement. The oxides, and principally the sesquioxide of iron, have a great affinity for phosphoric acid, and will retain it with a strong force; the substances, however, accompanying iron ores, as alkalis, alkaline earths, and alumina, have a still greater affinity for phosphoric acid than even sesquioxide of

will have taken up in the process of formation of iron ore-beds,—may this have been a dry or a wet process,—most of the phosphoric acid, so that the iron ore proper, it being considered a mixture of a pure compound of iron with some gangue, or as the Germans call it, "begleiter," will only contain a very small amount of it. This amount of phosphoric acid, which necessarily is contained in iron ores, will be less in the magnetic than in the hematite varieties, inasmuch as the strong combining power of the sesquioxide in the former has been satisfied to some extent by the protoxide present, and we are therefore able to obtain, under similar conditions, a better iron from those than we can from hematites.

"This slight amount of phosphoric acid in the iron ore proper will enter into the mass of metallic iron by the process of reduction and smelting, and in combination with other constituents give it its distinctive character. This small percentage of phosphorus in metallic iron I hold to be necessary to constitute it a good article; and I do not doubt that a less amount of it, as in the case of iron made from some magnetic and titanite varieties, will be substituted there by some other substance, say sulphur or carbon. A difference in the relative proportions of carbon, sulphur, and phosphorus, will change the properties of the metal in a way to render it more or less adapted to certain practical uses. As, however, very few exact analyses of metallic iron exist, we first have to ascertain those proportions of carbon, sulphur, and phosphorus, and their relations to the changes they effect in the properties of pure iron, before we are able to produce an iron of a certain character by the mixing of different ores the composition of which we know.

"We have also to distinguish two things, the phosphoric acid in the ore proper, and the phosphoric acid in the gangue. This latter I believe to be comparatively easy to eliminate and bring completely into the slag. The proof of this, and an attempt to remove an excess of phosphoric acid that by some peculiarity of composition or form may have entered into combination with the ore proper, will be the subject of another series of experiments which at some future time I will have the honor to bring before the Lyceum."

A Frozen Mine. The Theory of Dew.

NEAR Georgetown, Clear Creek Co., Colorado, in about the latitude of Washington, pretty extensive mining operations are carried on in soil and rock which are perpetually frozen. This frozen ground is part, and probably the greater part, of a hill or mountain which rises above the surrounding plateau only about 1,500 feet. During the summer the soil thaws to the depth of a few feet, and sufficient to permit a good crop of grass; in winter everything is solid. Three mining tunnels or levels, of the length respectively of 250, 180 and 100 feet, have been led into the mountain, and still no limit to the ice is reached. The mining operations are, of course, not impeded by running water, but in place of water the ice has proved to be about as great a nuisance. The rock is saturated with ice, and the ice is abundant in the fissures. It is found necessary to thaw out the rock as a preliminary to the ordinary mining work. Fires are therefore kept burning during the night, and in the morning they are extinguished, and the mine cleared of smoke for the workmen. As it is practicable in this way to thaw

only the roof of the mine, the blasting and digging is all upward.

The frozen ground extends neither to the top nor the bottom of the hill, but occupies the space between. At the foot of the hill is a gorge in which there is a stream of water in the early spring and late in the fall. In the neighborhood are other hills, but the ice phenomenon has not been noticed in them.

The particulars of this interesting case are furnished by Mr. Frank Dibben, who has resided near the spot for several years. The theory which he proposes seems sufficient and satisfactory. Indeed, the statement of the further material facts will make the explanation evident. It is only the north side of the hill which is frozen, the side on which the sun's rays never fairly strike; the frozen side is in the shade. The plateau on which the hill rests is 10,000 feet above the sea-level, and consequently the surrounding air is thin and dry. Such air does not easily become warmed by the sun, and thus assists very little in conveying warmth to the shady places. Moreover, it becomes a positive cooling agent by promoting rapid evaporation, and radiation of heat into space goes on freely through it. And to sum up the whole matter, very little sun-heat directly and fairly strikes the frozen side, and that little is neutralized by free radiation and evaporation.

In the neighborhood of this mountain the clear summer nights are always cold, and when the proper precautions are taken, water may be frozen with certainty and economically. Mr. Dibben has observed that the freezing of water under a clear summer sky is due more to the rapid evaporation of the water, than, as is stated in many of the text-books, to the radiation of heat into space. The importance of radiation in this case, and in the theory of dew and frost, is greatly overestimated.

The Pairing of the Elements a Test of the Atomic Numbers.

WE propose the pairing of the elements as exhibited in the April SUPPLEMENT as a new confirmation of the modern atomic weights, and of the doctrine of atomicity.

The fact of the pairing cannot be denied, and it is so conspicuous that it cannot be attributed to chance. No accidental mixing up of the names of the elements would allow them to be brought out in two columns with such extraordinary coincidences as our table shows; if a deliberate attempt were made to pair the elements of even and odd atomicities, independent of the atomic numbers, it would result in a table substantially such as we have presented. The purpose or the utility of the pairing is, indeed, not so evident; when it becomes so, the pairing will be established as a natural law.

The pairing does not appear to be the result of any of the known properties of matter, and is thus a new and independent phenomenon. Any arrangements based on it, and consequences deduced from it, may therefore stand alone, and have an independent force; they may serve to confirm or to refute, or to test other statements.

Now the pairing is exhibited by an arrangement depending upon certain atomicities and atomic numbers. If the pairing can be brought about only by certain exact conditions, there is a peculiar virtue in the conditions. Here is a remarkable relation of numbers, atomicities, and pairing, and these three facts are at the same

time quite independent of each other, and neither is comprehended in another. Here are facts of different sorts, obtained in different ways, and for different purposes, and which, when brought in conjunction, develop a new and remarkable relation. This new relation is a confirmation and test of the authenticity of the facts.

The atomic numbers and the doctrine of atomicity develop an unsuspected harmony; they are in beautiful accord with other facts which were not known to have any relation with them. Truth is always consistent with other truth, and the very harmony is sometimes sufficient to establish the truth. The atomic numbers and the doctrine of atomicity are true, by reason of harmony with the laws of gaseous volume, specific heat, &c.; and now for the new reason that they pair the elements among themselves, in accord with their well-known properties.

That new criteria or tests of atomic numbers are by no means superfluous, is apparent when we observe that the determination of the numbers which are now accepted has employed the best genius and talent of the chemical world for more than fifty years, while the material considerations which were the basis of all the estimations were known or suspected from the beginning. It is only within the past ten years that the arguments have been fully summed up and a final judgment recorded. The recognized tests of atomic numbers are not altogether what is to be desired. Some of them are, in certain cases, wholly inapplicable, or even give conflicting results. It is only by a careful comparison of all the facts in a case, and a process of reasoning, that any number is established. Moreover, the fundamental facts rest upon the testimony of a very few experimenters, and they cannot be verified except at great cost. The test of the pairing, although not so important as the other tests, is yet one that all can easily apply and understand, and it may be that it will secure the decision in doubtful cases.

A Question in Mechanics.

We have received a communication from Professor Henry F. Walling, of La Fayette College, Easton, Pa., on the question in mechanics which we presented in the January supplement. The letter commences by alluding to the origin of the discussion of the question, and to the fact that mathematicians of eminence are still divided among themselves; asserts that the expressions MV and MV^2 are both proper, but independent measures of force; and then continues as follows:—

"We may avoid all confusion in this matter by adopting the modern expedient of giving different names to the same agent, in considering the different effects which it causes. If we define force to be that which, when associated with matter, causes it to move, the appropriate measure of quantity of force is 'quantity of motion,' or *momentum*, represented by MV ; but when we consider the *work* which is performed, or to be performed, we find it convenient to use a unit of measurement entirely different in its nature from that of quantity of force or motion; and when measured by this unit, we term the acting cause '*power*' or '*energy*.' The performance of work may be generally defined as the moving of bodies, or parts of bodies, through certain definite spaces, against continuous 'resistances,' or opposing forces. It may be represented in the form of an equation, thus— $P=ps$, proportional to MV^2 , in which P represents the quantity

p , the continuous pressure, or its equal, the resistance; and s , the distance passed through.

"If any doubt should arise as to which measure is the proper one to make use of, we have only to ask ourselves what kind of effects are to be taken into consideration. In all the operations in which muscular power or motive power of any kind, acting through machinery, is concerned, *space effects* are what we have to do with—that is, we have to estimate the spaces through which matter is moved against opposing force; and ps , or its equivalent, MV^2 , becomes the convenient and proper measure. On the other hand, when we consider the effect of a uniformly acting force like terrestrial gravity (within narrow limits), in giving motion to a body freely acted upon, we see that the force which becomes associated will be directly as the time—that is, equal increments of force will be added in equal times; and since we find that equal increments of velocity are also added, we have $F=ft$, proportional to MV : F representing the entire associated force; f , the force developed in a unit of time; and t , the time.

"In applying these principles to any 'question in mechanics'—that of the railway-train, for instance—it is only necessary to state the question clearly, and its answer is easily given. There are circumstances attending the motion of the train which tend to complicate the solution of the problem, namely, the resistance of the air, friction, &c. Frictional resistance is a consequence of motion imparted to molecules, by which their heat is augmented; the resistance of the air is simply due to its inertia, and thus a large part of the power of the locomotive is consumed in space effects upon the air, and the atoms or molecules of the rails, wheels, axles, &c. Having no exact means of determining the aggregate amount of these motions, we can only ascertain it by actual experiment.

"We may, however, simplify the question by supposing the rails to have just sufficient inclination downwards in all parts of the train's progress to exactly balance the external resistances above mentioned. If, now, you would know the *moving force* required to give the train a certain velocity, it is clearly measured by MV , as shown in the previous editorial article; but if you wish to estimate the *work done* in giving it this velocity, or the work the moving train is capable of doing, if rendered independent of the locomotive, as the distance on a level, or up an inclined plane, it will move against a constant resistance, this quantity must be measured in units of its own kind—that is, of ps , proportional to MV^2 .

"In estimating the amount of coal which must be consumed to perform a certain amount of work, we may suppose that the effect is due to the *falling together* of the atoms of carbon and oxygen, increasing the molecular motion or heat of the compound atoms of carbonic acid thus formed. This motion is transferred to the aqueous molecules, converting them into steam; the molecular motion of the steam imparts motion to the piston of the locomotive, and, finally, to the train itself. The sum of all the atomic weights, or rather attractions, multiplied by the distance through which the atoms have fallen, is the amount of work which they are capable of doing. Hence the power thus generated is measured in units of ps , and is in direct proportion to the quantity of coal consumed.

"We perceive, to sum up, that while MV is the true measure of pure *force*, as an abstract quantity, ps or MV^2 is the proper measure for *power* to perform all mechanical operations."

The Physical Basis of Life.

A DISCOURSE, under the above title, by Professor Huxley, of London, has become one of the great sensations of the day. It was first read to an audience in Edinburgh, November 18th, 1868, and next appeared as the leading article of the *Fortnightly Review* for February, 1869. It attracted so much attention that five editions of the *Review* containing it were printed and sold. In America it has appeared, at least, in three periodicals and in two pamphlet editions. Its discussion has been the order of the day among all thoughtful people.

The discourse is somewhat unfriendly to the prevailing religious sentiment, and many suppose that it contains new facts and reasonings which bear on the relation of mind and matter. The discourse is spoken of as a defence of materialism, and a denial of the existence of spirit independently of matter; in short, it is supposed that Professor Huxley admits no other basis of life than the physical. These views of the discourse, it seems to us, are not altogether well founded. Professor Huxley describes, under the name of protoplasm, a peculiar sort of microscopic matter which has an appearance of vitality, and which is found in the sap of plants and the blood of animals. He supposes that out of protoplasm all other organisms are constructed. It should be observed that protoplasm is as yet only a theory; and we do not see that any objectionable materialism is a logical consequence of it. Mind and matter, to us, practically and really are two distinct things, although in life they are so joined together that we cannot understand how they may be separated. There is here a mystery which physical science may never penetrate. In her present feebleness should she attempt it? Has science anything legitimately at all to do with the question? If we were able to exhibit the proximate causes of vital motions, or to demonstrate the dictum "Ohne phosphor keine gedanke," we have made no progress towards determining whether mind is matter, or can exist apart from matter. Protoplasm, if there is such a substance, is a curious and important physiological fact; but it is only another link of the material chain, and leads us practically no nearer to the junction with the spiritual. Granted protoplasm, and nothing comes of it. To say that life has a physical basis is no more than to recognize facts with which all are familiar. Man was created from the dust of the ground; he is constituted out of what he eats and drinks. Living things originate from germs which are almost microscopic; and yet from such, by aggregation of other matter, we at last have the oak or the leviathan, and man himself. Yet how partial and unsatisfactory is such a statement. It throws not the feeblest ray of light on the existence of the metaphysical, or its relation with matter. Life has a physical basis, and science may teach us about it; and there is something else of life with which science is not at all concerned.

State Geological Surveys.

THE legislatures of several of the Western States, at their late sessions, made appropriations for geological surveys. Ohio votes \$14,000 per annum; and probably Professor J. S. Newberry, of this city, will superintend the work. Michigan votes \$5,000; and Professor Winchell, of Ann Arbor, will again take the field. E. T. Cox, of New Harmony, will explore Indiana. A new appropriation has been made to complete the survey of Illinois, now in charge of Professor

A. H. Worthen. In the East we have heard of no new survey except that of New Hampshire, which is to be pushed with vigor, by Professor C. H. Hitchcock, the coming season.

NEW PUBLICATIONS.

TREATISES ON SIGHT, COLOR, ELECTRICITY AND MAGNETISM. By John Ferdinand Jencken, M.D. Translated and prefaced by Historical and Critical Essays. By Henry D. Jencken, Barrister at Law, M.R.S., F.R.G.S., &c., &c. Pp. 232. London: Trübner & Co. New York: John Wiley & Son.

THIS is not a common sort of book. It is conspicuously original in thought and style. As a sample of it we quote at random p. 237: "Vibration is consequent to us on all, but infinitely accelerated exchange; and the ether, like every element in fact, is the exponent of the process of a force taking its origin in the primary laws of Being and Becoming to Be. And as Being can but exist as also a Becoming to Be, no power can exist without action, and this action is realized as change of power, in endless succession and onward progress, and transmutation from the finest to the coarsest, and from that to individual distinctive formation; hence, every power is at the same time an elementary material."

THE ELECTRO-CHEMICAL BATH: Founded 1855. Its use and effects illustrated in a Series of Scientific Documents and Autograph Testimonials from patients treated and cured by its means, under the direction of the Inventor, J. F. I. Caplin, M.D., F.A.S., &c., Medical Electrician (by appointment) to the French Hospital, London, &c., &c. "What Art cannot perform, Nature alone accomplishes." Third Edition, revised and enlarged. Pp. 266. London: Trübner & Co. New York: John Wiley & Son.

THUNDER AND LIGHTNING. By W. De Fontville. Translated from the French by T. L. Phipson, Ph.D., F.C.S., &c. Illustrated with 39 engravings on wood. Pp. 285. New York: Charles Scribner & Co.

THE WONDERS OF OPTICS. By F. Marion. Translated from the French and Edited by Charles W. Quin, F.C.S. Illustrated with 70 engravings on wood and a colored Frontispiece. Pp. 276. New York: Charles Scribner & Co.

THESE books are the auspicious beginning of a series intended to show forth the wonderful facts of science. Coming from the French, they present the subjects in a livelier style than what we are accustomed to. The books abound in new facts, curious stories, and novel views. They are good books for young people, and yet they are quite as well suited to the maturer tastes of the heads of families. We have great pleasure in commending such books to the general public.

LESSONS IN ELEMENTARY CHEMISTRY, INORGANIC AND ORGANIC. By Henry E. Roscoe, B.A., F.R.S., Professor of Chemistry in Owens College, Cambridge. New Edition. Pp. 458. London: Macmillan & Co. New York: D. Van Nostrand. (All rights reserved.)

THIS book is esteemed by many of those most capable to decide, to be the very best class-book of Modern Chemistry which has yet appeared. And this is a very high compliment, for it competes with the successful efforts of Williamson, Hoffmann, and other eminent men. It is, we are informed, quite extensively used as a class-book in England, and has recently been adopted at Columbia College. The present edition was revised by the author in January, and is probably free from all discoverable errors.

PAMPHLETS.

THE AMERICAN JOURNAL OF OBSTETRICS AND DISEASES OF WOMEN AND CHILDREN. Edited by E. Noeggerath, M.D., late Professor of Obstetrics and Diseases of Women and Children in the New York Medical College; and B. F. Dawson, M.D., Lecturer on Uterine Pathology in the Medical department of the University of New York. February. Pp. 321-448. New York: Townsend & Adams.

THE success of this handsome periodical has been so great that the publishers have been obliged to double the edition with which they commenced, and to reprint the first two numbers. Also, they are encouraged to make some valuable improvements in the new (2d) volume, which commences in May. 182 pages are to be added to the size of the volume, and the editorial staff is to be strengthened by the co-operation of Prof. A. Jacobi of this city, who has an enviable eminence in his profession as an author.

ON THE PHYSICAL BASIS OF LIFE. By T. H. Huxley, LL.D., F.R.S. Pp. 24. Yale College, New Haven, Conn.: The College Courant.

THIS is a reprint of a leading article of the *Fortnightly Review* for February, 1869.

CONTRIBUTIONS TO GYNÆCOLOGY, No. 3. A case of Retroversion of the Uterus, of eighteen years' standing, successfully treated by Ely-trorhaphia, with Clinical Remarks, to which is added a supplemental history of the same case. Read before the New York Obstetrical Society. By John Byrne, M.D., etc., surgeon of St. Mary's Female Hospital of Brooklyn. Pp. 22. New York: Townsend & Adams.

Burgundy Pitch, true	per lb	to	15
Cadmium, Bromide	per oz	to	55
Iodide	per oz	to	70
Metallic	per lb	to	4 60
Sulphate	per lb	to	8 00
Caffeine	per oz	to	9 00
Calcium Chloride	per lb	to	36
Iodide	per lb	to	8 50
Calisaya Bark, Milhau's Original Elixir of	per doz	to	11 00
Calisaya Bark, Milhau's Chalybeate Elix. of	per gross	to	120 00
" " "	per doz	to	11 00
" " "	per gross	to	120 00
Calomel, Hydrosulph.	per lb	to	95
Camphor, Refined	per lb	to	1 10
Cannella Alba	per lb	to	35
Cantharides, powdered	per lb	to	2 00
Carbolic Acid crystals	per oz	to	17
" " solution	per lb	60	to 85
" " common	per lb	to	35
Carbon Bi-Sulphuret	per lb	to	38
Cascarilla Bark	per lb	to	20
Cassia Buds	per lb	to	1 20
Caster Oil	per gal	9 75	to 2 50
Caustic Soda	per lb	to	9
Centaur Minor	per lb	to	38
Cerium, Oxalate	per oz	to	1 60
Nitrate	per oz	to	1 75
Chalk Precip., English	per lb	to	28
Cherry Laurel Water	per lb	to	58
Chlorate Potass, English	per lb	to	50
Chloride Lime	per lb	to	8
Chloroform	per lb	to	1 38
Cinnamon, Ceylon, true	per lb	to	1 75
Citrine Ointment	per lb	to	58
Civet	per oz	to	5 50
Cobalt	per lb	to	23
Cocculus Indicus	per lb	to	36
Cocoa Butter	per lb	1 00	to 1 15
Codine	per dr	to	2 50
Cod Liver Oil	per gal	to	2 35
Cod Liver Oil, ("Shore Oil")	per gal	to	2 25
Cod Liver Oil, J. C. Baker & Co.'s	per doz	to	8 00
" " "	per gross	to	90 00
" " "	5 gross, per gr	to	87 00
Cod Liver Oil, Hazard & Caswell's	per doz	to	7 50
" " "	per gr	to	90 00
Cod Liver Oil, Milhau's Golden	per doz	to	7 00
Milhau's Etherized	per gross	to	78 00
Cod Liver Oil, Milhau's, with the Hypo-	per doz	to	7 50
phosphite of Lime	per gross	to	84 00
Collodion	per lb	to	1 70
Cantharidal	per doz	to	4 50
Colocynth, powdered	per lb	to	75
Confectio Rosæ	per lb	to	48
Senna	per lb	to	48
Conium Leaves	per lb	to	25
Conin	per oz	to	7 50
Copper Ammoniated	per lb	to	1 20
Black Oxide	per lb	to	2 20
Carbonate	per lb	to	2 20
Sulphur, pure	per lb	to	38
Copperas	per lb	to	4
Corrosive Sublimate	per lb	to	92
Cream Tartar, powdered, pure	per lb	to	50
Cubebs	per lb	to	38
Cubeb	per dr	to	25
Cuttlefish Bone	per lb	28	to 30
Digitalis Herb.	per lb	to	18
Digitaline	per dr	to	8 65
Dover's Powder	per lb	to	3 00
Dragon's Blood, mass	per lb	to	1 00
reeds	per lb	to	1 10
Dulcamara Stems	per lb	to	18
Emetine	per oz	to	8 65
Emery Corn	per lb	to	11
Flour	per lb	to	8
Epsom Salts	per lb	to	4 1/2
Ergot, new	per lb	to	1 30
Ergotine	per oz	to	1 15
Ether, Acetic	per lb	to	85
Butyric, concentrated	per lb	to	4 10
Butyricaceous	per lb	to	1 60
Chloric	per lb	to	70
concentrated	per lb	to	85
Formic	per lb	to	4 00
Sulphuric	per lb	to	70
washed	per lb	to	50
concentrated	per lb	to	1 05
Extr. Jockey Club, Chris.	per lb	to	3 65
Extr. Ess. Bouquet, Chris.	per lb	to	3 75
Extr. Banana, superior	per lb	to	1 25
Extr. Orange, superior	per lb	to	1 25
Flour Spar	per lb	to	16
Flowers, Althea	per lb	to	42
Arnica	per lb	to	26
Borago	per lb	to	95
Chamomile, German	per lb	to	35
Chamomile, Roman, 1867	per lb	to	50
Lavender	per lb	10	to 9
Malva, large	per lb	30	to 40
small	per lb	to	35

Flowers, Rosemary.....	per lb	to 70	Lactucarium.....	per oz	to 75
Tillae.....	per lb	to 70	Lead Acetate, pure.....	per lb	to 90
Violet.....	per lb	to 68	Licorice Paste, solid.....	per lb	to 40
Fusel Oil, purified.....	per lb	to 2 25	Sicily.....	per lb	to 30
Ferro - Phosphated Elixir of Calisaya.....	per doz	to 12 00	Calabria.....	per lb	to 43
Bark, Hazard & Caswell's.....	per gra	to 144 00	Imitation.....	per lb	to 37
Gamboge.....	per lb	to 1 80	Barracco.....	per lb	to 44
Gelatin, French Pink.....	per lb	to 1 45	P. S.....	per lb	to 45
Gelatin, White French.....	per lb	85 to 1 00	Lime, Carbonate, Precipitate.....	per lb	to 22
Cox's.....	per doz	to 2 50	Hypophosphite.....	per lb	to 3 75
Ginger, Jamaica, bleached.....	per lb	to 80	Iodide.....	per lb	to 8 50
Ginseng.....	per lb	to 85	Phosphate, Precipitate.....	per lb	to 40
Glauber Salts.....	per lb	3 to 4	Sulphite.....	per lb	to 31
Glycerine, common.....	per lb	to 85	Lime Juice.....	per gal	to 80
concentrated.....	per lb	to 50	List, Taylor's.....	per lb	to 1 80
"Bowers".....	per lb	to 80	Lapis Calaminaris.....	per lb	to 8
"Price's".....	per lb	to 1 15	Laurel Berries.....	per lb	to 12
Glycerole Hypophosphite.....	per lb	to 1 75	Leaves.....	per lb	to 12
Grains D'Ambrette.....	per lb	to 60	Liquid Styrax.....	per lb	to 60
Paradise.....	per lb	to 32	Long Pepper.....	per lb	to 90
Gum Acroides.....	per lb	to 24	Lunar Caustic, pure.....	per oz	to 1 30
Amber.....	per lb	to 50	67 per cent, N. S.....	per oz	to 90
Ammoniac.....	per lb	to 60	Lycopodium.....	per lb	to 70
Arabic, Turkey, sorts.....	per lb	to 55	Magnesia Carbonate.....	per lb	to 45
1st picked, Trieste.....	per lb	to 95	Calcined.....	95 to 1 20	
2d ".....	per lb	to 75	ponderous.....	per lb	to 1 80
3d ".....	per lb	55 to 60	Citrate.....	per lb	to 1 75
Barbary.....	per lb	to 40	Sulphite.....	per lb	to 1 20
Assafetida.....	per lb	to 55	Manganese, powdered.....	per lb	to 8
Benzoin, common.....	per lb	to 90	Saxony.....	per lb	to 12
prime.....	per lb	to 1 00	Manna, small flake, '68.....	per lb	to 1 78
white marbled.....	per lb	to 1 10	large flake, '67.....	per lb	to 2 50
Copal, Accra.....	per lb	to 80	sorts, new.....	per lb	to 1 40
Benguela.....	per lb	to 45	Matico Leaves, true.....	per lb	to 50
Kowrie.....	per lb	to 60	Mercury.....	per lb	to 85
Damar, Batavia.....	per lb	to 55	eum Creta.....	per lb	to 52
Singapore.....	per lb	to 55	Magnesia.....	per lb	to 1 22
Elemi, Aromatic.....	per lb	to 55	Cyanuret.....	per lb	to 5 80
Euphorbium.....	per lb	to 25	Sulphuret.....	per lb	to 80
Galbanum.....	per lb	to 1 00	Mercurial Ointment (1/2 M).....	per lb	to 65
strained.....	per lb	to 1 25	(1/2 M).....	per lb	to 56
Gedda.....	per lb	to 30	Morphia Sulphate.....	per oz	to 13 00
Guaiacum.....	per lb	50 to 60	Acetate.....	per oz	to 13 00
strained.....	per lb	to 60	Muriate.....	per oz	to 13 00
Kino.....	per lb	to 80	Valerianate.....	per oz	to 15 00
Mastic.....	per lb	to 4 25	Musk, true.....	per oz	to 16 00
Myrrh, Turkey, powdered.....	per lb	to 75	in grain true.....	per oz	to 23 00
Olibanum.....	per lb	to 30	Nox Vomica.....	per lb	to 14
tears.....	per lb	to 40	Oil, Amber, Crude.....	per lb	to 60
Sandarac.....	per lb	to 65	Almonds (Expressed) Allen's.....	per lb	to 90
Shellac, Campbell's D. C.....	per lb	to 60	Essential, Allen's.....	per lb	to 24 00
Garnet.....	per lb	to 55	Anise.....	per lb	to 4 25
No. 2.....	per lb	to 48	Bergamot.....	6 00 to 7 00	
Native.....	per lb	to 48	FF, new crop.....	per lb	to 6 50
Senegal.....	per lb	to 50	Bergamot, Donner's.....	per lb	to 6 75
Tragacanth, common.....	per lb	to 50	Bergamot, —Sanderson's.....	per lb	to 6 75
flake.....	per lb	1 80 to 1 50	Cade.....	per lb	to 1 00
flaky sorts.....	per lb	to 60	Cajuput.....	per lb	to 2 00
Harlem Oil, Dutch.....	per doz	to 60	Camphor.....	per lb	to 1 75
Hoffman's Anodyne.....	per lb	to 48	Caraway.....	per lb	to 2 75
Hydriodate Potash, Atkinson's.....	per lb	to 5 40	Seed.....	per lb	to 3 50
Conrad's.....	per lb	to 5 20	Cassia.....	per lb	to 4 00
Hyoxyanth Leaves.....	per lb	to 26	Cinnamon, true.....	per oz	to 1 50
Hypophosphite Ammon.....	per lb	to 3 75	Citronella, prime.....	per lb	to 2 65
Iron.....	per lb	to 8 50	Winter's.....	per lb	to 3 25
Lime.....	per lb	to 8 75	Copaiba.....	per lb	to 3 00
Manganese.....	per lb	to 14 00	Croton.....	per lb	to 4 00
Potash.....	per lb	to 3 75	Cubebs.....	per lb	to 4 00
Soda.....	per lb	to 3 75	Cumin.....	per lb	to 10 00
Iceland Moss.....	per lb	10 to 12	Fennel.....	per lb	to 3 00
Indian Hemp, true.....	per lb	to 1 60	Geranium.....	12 00 to 23 00	
Insect Powder, true.....	per lb	to 1 10	Chiriz.....	per lb	to 18 00
Iodine, Resublimed.....	per lb	to 6 75	Prepared.....	per lb	to 25 00
Crude, in bulk.....	per lb	to 6 50	Turkish.....	per lb	14 00 to 18 00
Irish Moss.....	per lb	to 10	Jessamine.....	per lb	to 3 50
Iron, Alum.....	per lb	to 1 60	Juniper.....	per lb	to 1 20
by Hydrogen.....	per lb	to 2 80	Berries, true.....	per lb	to 3 50
Carb. Proto.....	per lb	to 45	Lavender, Garden, forte.....	per lb	to 1 65
Precip.....	per lb	to 25	fine.....	per lb	to 1 85
Citrate and Ammonia.....	per lb	to 1 45	Flowers, Chiriz, No. 1.....	per lb	to 3 75
Magnesia.....	per lb	to 1 85	Lavender Spike.....	per lb	to 1 00
Quinine.....	per lb	to 10 00	Laurel, Expressed.....	per lb	to 90
Strychnine.....	per lb	10 00 to 12 50	Lemon, Donner's.....	per lb	to 4 25
Hypophosphite.....	per lb	8 40 to 8 50	Lemon, —G. R. & Co's.....	per lb	to 4 50
Iodide.....	per lb	to 8 25	—Sanderson's (new).....	per lb	to 4 50
Syrup.....	per lb	to 80	Lemongrass, —Winter's.....	per lb	to 7 00
Lactate.....	per lb	to 3 25	Mace, Expressed.....	per lb	to 2 50
Phosphate, Precipitate.....	per lb	to 67	Marjoram.....	per lb	to 1 75
Pyrophosphate.....	per lb	to 1 75	Myrrbane.....	per lb	to 2 00
Syrup.....	per lb	to 65	Neroli Bigarade.....	per oz	to 5 00
Sesquichloride.....	per lb	to 1 45	Chiriz.....	per oz	to 4 75
Sol.....	per lb	to 60	Petit Grain.....	per lb	to 25 00
Sesquinitrate.....	per lb	to 44	Olive, pure.....	per gal	to 2 00
Subsulphate.....	per lb	to 1 70	Marseilles, quarts.....	per box	to 6 00
Sulphate, pure.....	per lb	to 9	pinta.....	per box	to 7 25
Exsleat.....	per lb	to 17	Orange.....	per lb	to 4 25
Sulphuret.....	per lb	8 1/2 to 8 1/2	Origanum.....	per lb	75 to 1 40
Superphosphate Syrup.....	per lb	to 65	Patchouly.....	per oz	to 4 25
Tannate.....	per lb	to 6 00	Pennyroyal.....	per lb	8 75 to 4 00
Indra Ink.....	per lb	to 1 75	Peppermint, pure.....	per lb	6 25 to 6 50
Leiglass, American.....	per lb	to 1 95	Rhodum.....	per lb	to 10 00
Russian, true.....	per lb	to 6 50	Rose, Klissulick.....	per oz	to 10 00
Juniper Berries.....	per lb	to 6	Rosemary, French.....	per lb	to 1 75
Juniper Tar Soap, Hazard & Caswell's.....	per doz	to 3 75	Trieste.....	per lb	to 1 75
Kreosote, white.....	per lb	to 1 10	Chiriz.....	per lb	to 2 25

Oil, Sabine, pure.....	per lb	to 1 80	Scammony, virg., true.....	per lb	to 20 00
Sassafras, cans.....	per lb	to 1 10	Seeds, Anise.....	per lb	to 25
Sesame, Salad, fine.....	per lb	to 2 50	star.....	per lb	to 55
Spearmint, Hotchkiss.....	per lb	to 6 50	Canary, Dutch.....	per bush	to 4 75
Spice.....	per lb	to 60	Smyrna.....	per bush	to 4 75
Succinum, crude.....	per lb	to 70	Cardamom, Malabar.....	per lb	to 4 60
retified.....	per lb	to 5 00	Carul.....	per lb	to 22
Tanzy, "Eastman's".....	per lb	to 2 75	Celery.....	per lb	to 75
Thyme, white, pure.....	per lb	to 18 00	Clover.....	per lb	to 16
Valerian.....	per lb	to 5 00	Colchicum.....	per lb	to 24
Wintergreen.....	per lb	to 5 00	Coriander.....	per lb	to 18
Wintergreen, Van Deusen Bros.....	per lb	to 7 00	Cummin.....	per lb	to 30
Wormwood.....	per lb	to 2 75	Fennel.....	per lb	to 20
Wormseed, Western.....	per lb	to 8 50	Fennugreek.....	per lb	to 12
Baltimore.....	per lb	to 1 25	Hemp.....	per bush	to 2 25
Black Pepper.....	per oz	to 8 50	Linseed, American clean.....	per tierco	to 2 50
Cognac.....	per oz	to 25	rough.....	per bush	to 2 50
Ergot.....	per lb	to 19 00	Bombay (gold).....	per bush	to 2 50
Orange Buds or Apples.....	per lb	to 18	Calcutta (gold).....	per bush	to 2 55
Curacao Ribs.....	per lb	to 28	Mustard, brown.....	per lb	to 16
Otto Rose, pure.....	per oz	to 10 00	white.....	per lb	to 16
commercial.....	per oz	to 7 50	Rape.....	per bush	to 5 25
Peppers, Zanzibar.....	per lb	to 88	Timothy.....	per bush	to 5 00
Phosphorus.....	per lb	to 1 20	Worm.....	per lb	to 23
Amorphous.....	per lb	to 8 25	Selditz Mixture.....	per lb	to 45
Piperin.....	per oz	to 1 50	Senna, Tinnevely.....	per lb	to 50
Podophyllin.....	per oz	to 80	Alexandria.....	per lb	to 25
Poppy Heads.....	per lb	to 25	E. I.....	per lb	to 25
Potassa, Acetate.....	per lb	to 80	Smalts, Blue.....	per lb	to 22
Bicarbonate.....	per lb	to 35	Snuff, Lorillard's Maccaboy.....	per lb	to 78
Carbonate.....	per lb	to 20	Coarse Rappes.....	per lb	to 1 00
Caustic, common.....	per lb	to 65	Irish High Toast.....	per lb	to 85
white.....	per lb	to 95	Fresh Scotch.....	per lb	to 85
Citrate.....	per lb	to 1 15	Soap, Castile, Mottled.....	per lb	to 16
cum Calce.....	per lb	to 15	White.....	per lb	to 25
Hypophosphite.....	per lb	to 4 25	floating.....	per lb	to 25
Permanganate, ordinary.....	per lb	to 80	Low's Brown Windsor.....	per gra	to 15 50
Phosphate.....	per lb	to 2 75	Soda Acetate.....	per lb	to 80
Prussiate.....	per lb	to 44	Chlorate.....	per lb	to 2 15
Sulphate.....	per lb	to 16	Chloride, Liquor.....	per gal	to 45
Tartrate.....	per lb	to 1 05	Citrate.....	per lb	to 1 00
Potassium.....	per oz	to 8 75	Hydrosulphate.....	per lb	to 1 05
Bromide.....	per lb	to 1 65	Hypophosphite.....	per lb	to 4 10
Cyanide, fus.....	per lb	to 82	Hyposulphite.....	per lb	to 10
gran.....	per lb	to 1 50	Nitrate, pure.....	per lb	to 22
Iodide.....	per lb	to 5 25	Phosphate.....	per lb	to 81
Sulphuret.....	per lb	to 85	Pyrophosphate.....	per lb	to 1 25
Quinine, Citrate, with Iron.....	per oz	to 85	Sulphite.....	per lb	to 32 1/2
Sulphate, American.....	per oz	to 2 60	Ash.....	per lb	to 4
French.....	per oz	to 2 55	Sodium.....	per lb	to 11 00
Quassia, rasped.....	per lb	to 7	Iodide.....	per lb	to 8 00
Red Chalk, Fingers.....	per lb	6 1/2 to 7	Spirit Ammonia.....	per lb	to 48
Red Precipitate.....	per lb	to 1 15	Aromatic.....	per lb	to 1 0
Resin of J. lap, pure.....	per lb	to 28 00	Lavender.....	per lb	to 50
Rochelle Salt.....	per lb	to 48	Nitre Dole.....	per lb	to 40
Roots, Aconite.....	per lb	to 24	Rosemary.....	per lb	to 50
Alkanet.....	per lb	17 to 18	Sponges, Bahama.....	per lb	to 90
Althea.....	per lb	to 22	Bathing, Forme.....	per lb	to 4 00
Angelica.....	per lb	to 85	Coarse Brown.....	per lb	to 60
Calamus.....	per lb	20 to 60	Fine, medium.....	per lb	6 00 to 7 00
Colchicum.....	per lb	to 20	Surgeon's.....	per lb	4 00 to 7 00
Colombo.....	per lb	to 24	Zimoca.....	per lb	2 00 to 3 00
Culveris.....	per lb	to 20	Cup, Turkey.....	per lb	20 00 to 30 00
Dandelion.....	per lb	to 30	Trieste.....	per lb	4 50 to 13 00
Galangal.....	per lb	to 12	Fine Toilet, bleached.....	per lb	12 00 to 15 00
Gentian.....	per lb	to 15	Fine Trieste, small.....	per lb	4 00 to 4 50
Ginger, Race, African.....	per lb	to 20	Grove.....	per lb	1 75 to 2 00
Jamaica, Bleached.....	per lb	to 82	Grass.....	per lb	to 25
Golden Seal.....	per lb	to 30	Sheep's wool.....	per lb	1 60 to 1 70
Hellebore black.....	per lb	to 16	Sur Choix.....	per lb	to 5 50
white, powdered.....	per lb	to 85	Squills.....	per lb	to 12
Ipecacuanha.....	per lb	to 3 80	St. John's Bread.....	per lb	to 3
powdered.....	per lb	to 3 40	Strontia, Murate.....	per lb	to 80
Jalap.....	per lb	to 2 00	Nitrate.....	per lb	to 30
powdered.....	per lb	to 2 30	Oxalate.....	per lb	to 1 80
Licorice.....	per lb	to 13	Strychnia, Acetate.....	per oz	to 3 75
Mandrake.....	per lb	to 15	Citrate.....	per oz	to 75
Orris, Florentine.....	per lb	to 17	Nitrate.....	per oz	to 3 75
Verona.....	per lb	to 15	Pure, crystallized.....	per oz	to 3 50
Pink.....	per lb	to 33	powdered.....	per oz	to 3 25
Rhatany.....	per lb	to 80	Sulphate.....	per oz	to 3 75
Rhubarb, E. I.....	per lb	2 50 to 4 00	Valerianate.....	per oz	to 5 50
Turkey.....	per lb	to 24 00	Styrax Calamita.....	per lb	to 40
Sarsaparilla, Honduras.....	per lb	to 60	Sugar of Lead.....	per lb	to 63
Mexican.....	per lb	to 28	Sugar of Milk.....	per lb	to 7
Turbeth.....	per lb	to 60	Sulphur Sublime.....	per lb	6 1/2 to 10
Valerian, English.....	per lb	to 65	Tamarinds.....	per lb	to 75
Dutch.....	per lb	to 40	Tannin.....	per lb	to 16
German.....	per lb	to 26	Taploca, East India, white.....	per lb	to 13
Vermont.....	per lb	to 40	Pearl.....	per lb	to 95
Snake, Virginia.....	per lb	to 44	Tartar Emetic, powdered.....	per lb	to 1 15
Seneca.....	per lb	to 55	crystallized.....	per lb	to 1 45
Rose Leaves.....	per lb	to 2 50	Tin Foil, thin.....	per lb	to 80
Rosemary Leaves.....	per lb	to 12	French, No. 15.....	per lb	to 40
Rubigo Ferri.....	per lb	to 10	Tobacco.....	per lb	to 65
Saffron, American, new.....	per lb	to 2 25	Tonqua Beans, Para.....	per lb	to 19
Spanish, true.....	per lb	to 17 00	Augustora.....	per lb	to 13
Sago, Pearl.....	per lb	to 12	Uva Ursi, American.....	per lb	to 15
Salicin.....	per oz	to 60	French.....	per lb	to 11 00
Sal Acetosella.....	per lb	to 55	Vanilla Beans, Bourbon.....	per lb	to 15 00
Ammoniac.....	per lb	to 16	Mexican.....	per lb	to 53
Soda, Newcastle.....	per lb	to 6	Venice Turpentine.....	per lb	to 14
Santonine.....	per oz	to 1 30	Veratria.....	per oz	to 2 25
Sassafras Bark.....	per lb	to 12	Vitriol, Blue.....	per lb	to 2 1/2
			Green.....	per lb	to 2 1/2

Vitriol, White.....	per lb	to	9
Wax, White,—J. I. Elkins.....	per lb	to	75
No. 2.....	per lb	to	72
Phillips'.....	per lb	to	90
Yellow.....	per lb	to	52
White Wax,—Leonhardt's.....	per lb	to	90
Oakmid.....	per lb	to	82
Ann-bleached.....	per lb	to	80
White Precipitate.....	per lb	to	1 50
White Pepper.....	per lb	to	58
Wine, Colchicum Seeds.....	per lb	to	1 40
Wood Naphtha.....	per lb	to	95
Wormwood Herb.....	per lb	to	25
Yellow Bark.....	per lb	to	30
Dock.....	per lb	to	25
Zaffre.....	per lb	to	1 15
Zinc, Acetate.....	per lb	to	1 25
Chloride.....	per lb	to	1 80

DYES AND DYESTUFFS.

Aniline Blue.....	per lb	to	8 00
Red.....	per lb	to	7 50
Violet.....	per lb	to	8 00
Annatto.....	per lb	1 00	to 1 75
Cochineal, Honduras.....	per lb	to	1 40
Mexican.....	per lb	1 30	to 1 40
Cudbear.....	per lb	28	to 45
Cutch, Pegue.....	per lb	to	18
Gambier.....	per lb	to	8
Indigo, Bengal, fine.....	per lb	to	3 25
good.....	per lb	2 50	to 2 75
middling.....	per lb	2 00	to 2 10
Madras, fine.....	per lb	1 60	to 1 85
ordinary.....	per lb	to	1 25
Kurpah.....	per lb	to	15
Guatemala.....	per lb	2 00	to 2 10
Caracas.....	per lb	to	1 65
Lac Dye, good to fine.....	per lb	55	to 60
Logwood, Campeachy.....	per lb	to	2 1/2
Honduras.....	per lb	to	2 1/2
Jamaica.....	per lb	to	2 1/2
Launa.....	per lb	to	2 1/2
St. Domingo.....	per lb	to	2 1/2
Extract.....	per lb	18	to 16 1/2
" in bulk.....	per lb	to	13
Lima Wood (gold).....	per bbl	70 00	to 71 00
Madder, Dutch.....	per lb	22	to 24
French.....	per lb	28	to 25
Nutzalls, Blue, Aleppo.....	per lb	to	40
Ochre.....	per lb	80	to 85
Persian Berries.....	per lb	50	to 55
Safflower.....	per lb	60	to 65
Sapanwood.....	per lb	12	to 15
Turneric.....	per lb	15	to 16
Ultramarine.....	per lb	28	to 45
Wood.....	per lb	15	to 16

DRUGGISTS' GLASSWARE.

Green Bottles and vials.....	percentage discount.
German Flint Bottles and vials.....	30
Flint Bottles and vials.....	25
Furniture Ware.....	10
Perfumer's Ware.....	25
Chemical Ware.....	net
Syringes.....	10
Homeopathic vials.....	10

NAVAL STORES.

Pitch, City.....	per bbl	to	4 00
Rosin, Extra Pale.....	per 280 lbs	8 00	to
Pale.....	"	7 00	to
No. 1.....	"	5 00	to
No. 2.....	"	4 00	to
Strained.....	"	4 00	to
Common.....	"	to	3 75
Sprits, Turpentine (North Carolina).....	per gal	55	to 60
Turpentine, Soft.....	per 280 lbs	to	8 00

OILS.

Linseed Oil, American.....	per gal	to	1 10
English.....	per gal	to	1 10
Palm Oil.....	per lb	to	16
Paraffine Lubricating Oil.....	per gal	to	40
Sperm, Crude.....	per gal	to	2 10
Sperm, Winter, unbleached.....	per gal	to	2 20
Lard Oil Prime, City.....	per gal	to	1 80
Red Oil City distilled.....	per gal	to	70
Red Oil Saponified.....	per gal	to	78
Whale, Crude.....	per gal	to	1 35
Whale, Bleached, Winter.....	per gal	to	1 25

PAINTS (DRY).

Asphaltum, opt.....	per lb	to	7
Barytes, Foreign.....	per ton	to	45 00
Barytes, American.....	per lb	to	2
Black Lead.....	per lb	8	to 12
Black Ivory, drop, fair.....	per lb	10	to 18
good.....	per lb	18	to 20
best.....	per lb	24	to 28
Blue Celestial good.....	per lb	to	14
Chinese.....	per lb	to	1 00
Prussian, fair to best.....	per lb	85	to 1 00
Ultramarine, fair to best.....	per lb	28	to 45

Chalk, Lump.....	per lb	to	2 1/2
China Clay.....	per lb	to	2 1/2
Chalk.....	per bbl	to	4 10
Green Paris, fair to best.....	per lb	35	to 50
Green Chrome, fair to best.....	per lb	38	to 42
Lamp Black—Coach Painter's—L. Martin & Co.'s.....	per lb	23	to 25
Lamp Black, ordinary.....	per paper	8	to 12
Litharge, powdered, American & English.....	per lb	11	to 11 1/2
Ochre, Yellow, French, dry.....	per lb	2 1/2	to 4
Red Venetian.....	per lb	3 1/2	to 5
Red Indian, fair to best.....	per lb	11	to 18
Red Lead, American.....	per lb	11	to 12
English.....	per lb	to	14
Rose Pink.....	per lb	to	20
Sienna, American.....	per lb	7	to 9
Italian, Bnt.....	per lb	18	to 22
Raw.....	per lb	15	to 20
Umber, Crude, Turkey.....	per lb	5	to 7
burnt.....	per lb	8	to 9
Tieinan's Calif. Vermilion.....	per lb	to	1 10
Pure Carmine.....	per lb	to	14 00
Soluble Blue.....	per lb	to	1 25
Vermilion, English, pale.....	per lb	to	1 15
deep.....	per lb	to	1 20
American.....	per lb	to	85
Chinese.....	per lb	to	1 20
Trieste.....	per lb	to	1 20
White, China.....	per lb	to	22
Cremnitz.....	per lb	13	to 14
Lead, pure.....	per lb	9	to 11 1/2
good.....	per lb	8 1/2	to 4
Paris.....	per lb	to	12 1/2
Zinc, American.....	per lb	10	to 12 1/2
Zinc, French.....	per lb	14	to 16
Whiting.....	per lb	to	8 1/2

PAINTS (IN OIL).

Black coach.....	per lb	28	to 30
Blue, Chinese.....	per lb	90	to 1 00
Prussian, fair to best.....	per lb	35	to 80
Brown, Van Dyke, fair to best.....	per lb	20	to 28
Dryer, Patent, American.....	per lb	12 1/2	to 14
English.....	per lb	12 1/2	to 15
Green, Chrome.....	per lb	15	to 27
Imperial.....	per lb	15	to 18
Paris.....	per lb	88	to 42
Verdigris.....	per lb	25	to 68
Putty, in bladders.....	per lb	5 1/2	to 6
in bulk.....	per lb	to	5 1/2
Red Venetian, fair to best.....	per lb	8	to 16
Sienna, burnt, fair to best.....	per lb	22	to 35
White Lead, English, B. B.....	per lb	to	16
American, pure.....	per lb	13 1/2	to 14
good.....	per lb	11	to 13 1/2
fair.....	per lb	9	to 10
White Zinc, American.....	per lb	10	to 12
French.....	per lb	15	to 15 1/2
Yellow Ochre.....	per lb	9	to 10
Chrome, fair to best.....	per lb	16	to 32

SPICES.

Cassia, in mats.....	per lb	to	70
Cloves.....	per lb	to	42
Ginger, Race, African.....	per lb	to	19
Mace.....	per lb	to	1 55
Nutmegs, No. 1.....	per lb	to	1 45
Pepper.....	per lb	to	88
Pimento, Jamaica.....	per lb	to	24

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6 by 8 to 8 by 10.....	Per fifty feet \$	6 25 to 3 75
8 by 11 to 10 by 15.....	"	6 75 to 4 75
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 16 to 16 by 24.....	"	8 50 to 6 00
18 by 22 to 18 by 30.....	"	10 00 to 7 00
20 by 30 to 24 by 30.....	"	12 50 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 40.....	"	16 00 to 10 00
28 by 40 to 30 by 48.....	"	18 00 to 14 00
24 by 54 to 32 by 56.....	"	20 50 to 16 00
32 by 58 to 34 by 60.....	"	24 00 to 18 00
34 by 62 to 40 by 60.....	"	26 00 to 21 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6 by 8 to 8 by 10.....	Per fifty feet \$	6 25 to 4 75
18 by 11 to 10 by 15.....	"	6 75 to 5 00
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 18 to 16 by 24.....	"	8 50 to 6 00
28 by 22 to 18 by 30.....	"	20 00 to 7 00
20 by 30 to 24 by 30.....	"	12 00 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 40.....	"	16 00 to 10 00
28 by 40 to 30 by 48 (3 qlts).....	"	18 00 to 14 00
34 by 54 to 32 by 56 (3 qlts).....	"	20 50 to 16 00
32 by 58 to 34 by 60 (3 qlts).....	"	24 00 to 18 00
4 by 52 to 40 by 60 (3 qlts).....	"	26 00 to 21 00

Subject to a discount of 30 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.
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ON THE
METHODS AND RECENT PROGRESS OF
SPECTRUM ANALYSIS.*

BY A. S. HERSCHEL, B.A., F.R.A.S.,

PROFESSOR OF NATURAL PHILOSOPHY IN THE ANDERSONIAN UNIVERSITY
OF GLASGOW.

THE portion of the solar spectrum which is most generally visible under all circumstances of the atmosphere, and in which the bright-line spectra of the metals obtained with the spark of a Rühmkorff coil are most distinctly seen, is that contained between the Fraunhofer's dark lines A and G, at the least and most refrangible ends of the spectrum as it appears in Kirchhoff's maps, the last of which was published in 1863. The air-spectrum between the poles of an induction coil was subsequently employed by Mr. Huggins in his "Researches on the Spectra of some of the Chemical Elements," published in the *Philosophical Transactions* for 1864, as a standard of comparison with the bright-line spectra of the metals produced together with it in the induction spark. The superior heat of the voltaic arc being found to produce more vivid spectra of the elements, and to exhibit lines in the violet portion not usually seen with the induction coil, a blue line in the spectrum of lithium was thus first discovered by Professor Tyndall in addition to the orange line which Dr. Bunsen had detected in it by the application of a Rühmkorff coil. To extend Kirchhoff's scale of reference to the wider range of artificial spectra, the labour of completing the map of the solar spectrum by delineating the violet portion, and comparing it with the voltaic spectra of the chemical elements was carried out by Professor Angström with the assistance of Mr. R. Thalén, at Upsala; and the work was published in the *Proceedings of the Stockholm Academy* for February, 1865. Confining their attention chiefly to the iron spectrum produced by two stout iron poles of a Bunsen Battery of 50 cells, the specimen of this metal was found to contain so many bright lines, especially in the violet portion, that, in addition to 73 iron lines found by Kirchhoff and Hofmann to have counterparts in the dark solar lines between A and G, about 220 were added to the number in that space and 170 more between G and H, making the whole number of iron coincidences about 460, to which, it was believed, one or two hundred might have been added, had not the short summer and deficient sunlight in the high northern latitude put an end to their comparisons. With a greater battery power, and an equally extensive trial of other chemical elements, whose vapours appear to be present in the sun, the probability was suggested that the innumerable black lines of the solar spectrum, which still remain outstanding when those of iron are subtracted, may at length be accounted for without assuming the existence of chemical elements in the solar atmosphere, with which we are unacquainted on the earth. The solar character of four new sodium lines, which were first pointed out and their coincidence with Fraunhofer's lines was suspected by Mr. Huggins in his researches, was confirmed; while the agreement of a

prominent dark line about half-way between G and H, designated *h* by the authors, with a fourth line of the spectrum of incandescent hydrogen was established, proving, with the correspondences of the other lines at C, F, and G, the existence of that element in the sun. The metal manganese was placed for the first time on the list of solar elements, and 50 new correspondences of calcium lines were noted in addition to those already previously observed by Kirchhoff. In a Swedish work on spectrum analysis,* published in the following year, Mr. Thalén has compiled a very complete chart of spectra of the chemical elements, referred, like the above-mentioned chart of Mr. Huggins, to the bright lines of incandescent air, and continued, as far as they could be traced, to the violet end of the spectrum. It will easily be perceived that the addition of so many characteristic bright lines in the spectra of the chemical elements, by the use of the voltaic arc, by giving greater certainty to the results, facilitates, in a corresponding degree, the practical applications of the spectroscope. Moreover, in order to establish a natural scale for the uniform representation of artificial spectra, Professor Angström last year published a Normal Atlas of the Solar Spectrum,† in which the wave lengths of the Fraunhofer lines are employed to delineate them, so that the spaces between them represent the differences of their wave lengths enlarged to ten million times their natural dimensions. The most refrangible Fraunhofer line, *u*, occupies a point at 3,933 millimetres, and the least refrangible line, *a*, a point at 7,185 millimetres on the map, which are ten million times the wave lengths of those lines; and the entire map, consisting of six plates of two lines each, is 11 ft. 6 in. in length. The violet end of the spectrum in this projection is more compressed, and the red end more expanded, than corresponds to their natural appearance. If, however, in place of the wave lengths the number of impulses in a second, or their scale of pitch, as in musical notes, were employed for projecting the Fraunhofer's lines, a nearly natural representation of the prismatic spectrum would be obtained; and the above objection to the use of the normal scale, which may not, however, be of very great theoretical importance, might yet practically be removed with some advantage. A series of elementary bright-line spectra, showing their counterparts among the solar lines, is laid down in the margin of the map, with the following numbers of the corresponding lines of each, in their correct places on the scale, viz.:—Iron, 450; titanium, 116; calcium, 68; manganese, 63; nickel, 35; cobalt, 19; chromium, 18; barium, 10; sodium, 9;‡ magnesium, 7; copper, 7; zinc (blue lines), 2; aluminium (violet lines), 2; hydrogen, 4. By a series of remarkable coincidences, if not of absolute agreements, twenty-four lines of titanium, twenty-one of calcium, and four lines of manganese are represented in the map as corresponding exactly in their positions with iron lines. A similar agreement between a double line of nitrogen and a double line of oxygen was observed by Mr. Huggins in the spectrum of incandescent air,§ but

* "Spectralanalys, Exposé och Historik; Med en Spektrelkarta." Af Rob. Thalén, Upsala, Edquist & Berglund, 1866.

† "Spectre Normal du Soleil;" par A. J. Angström, Upsal, 1868. The plates are drawn by Mr. Thalén.

‡ Three of the new lines of the sodium spectrum are double, like the familiar D line, and the fourth is a narrow nebulous line, making the total number of nine separate bright lines in the spectrum of this vapour.

§ "Researches on the Spectra of some of the Chemical Elements," *Philosophical Transactions* for 1864, part ii.

* Abstract of a paper read before the Chemical Section of the Philosophical Society of Glasgow, on Monday, March 1st, 1869.

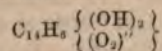
as the correspondence appeared, on closer examination, not to be absolutely perfect, it was shown to be probably an accidental, although certainly a most curious, coincidence. In Angström's Normal Atlas the air spectrum is placed on a parallel line with the solar spectrum, extending throughout its length, so as to include the lines of the elementary spectra between them. The comparison of the latter with either of the two standard scales is, accordingly, made a matter of easy reference. At the end of the atlas is placed a chart of the atmospheric dark lines and spaces of the solar spectrum, a large number of which are now known to owe their presence in it to the absorption produced by aqueous vapour in the earth's atmosphere. This cloudy group of lines is well characterized by Mr. Thalén as forming a faint ground, from which the two solar lines of the inverted metallic spectra, tolerably deep black and well defined, stand out, as if seen in perspective, in strong relief. In place of the four glass prisms used by Mr. Kirchhoff in his researches, a single bisulphide of carbon prism with a refracting angle of 60° , a collimator, and an astronomical telescope, each magnifying forty times, were found to be a sufficiently powerful apparatus to distinguish all the lines shown in Kirchhoff's maps, and to add to them the numerous lines recorded in the above-mentioned drawings by Mr. Thalén. From the foregoing description of their recent publications it will be seen that the operations of the Swedish observers continue to afford fresh data of practical value to spectral analysis, as well as some very important contributions of a novel and interesting kind to spectroscopic science.

ON THE

ARTIFICIAL PREPARATION OF ALIZARINE.

At the meeting of the Chemical Society of Belgium on the 24th of February, 1868, MM. Graebe and Liebermann communicated a memoir on alizarine, from which an intimate relation was acknowledged between this colouring matter and anthracene. By heating alizarine, according to M. Baeyer's method, with zinc dust, they obtained, as the sole product of reduction, a hydrocarbon having the composition $C_{14}H_{10}$, and presenting all the qualities of anthracene.

This curious fact caused alizarine to be considered as a derivative of anthracene. It also led MM. Graebe and Liebermann to reject the formula, then very generally allowed for alizarine, $C_{14}H_8O_3$, and to admit for this body the composition $C_{14}H_8O_4$, which they expressed by the rational formula—



Having thus obtained anthracene as a product of alizarine, MM. Graebe and Liebermann have since succeeded in solving the inverse problem, that is to say, the artificial preparation of alizarine by means of anthracene. The following account of their new discovery is published by these chemists in the *Rapports de la Société de Chimie de Berlin* (January 11th, 1869).—

"The properties of our product, as well as the colours which it has given us on mordanted cotton, prove the complete identity of artificial alizarine with that from madder root. We submit to the inspection of the Society samples of the colouring matter in a sublimed state, as well as specimens of cotton which have been dyed with this product. The proceedings which led us to this synthesis, and which we shall hereafter

describe, confirm the exactitude of the rational formula previously proposed by us for alizarine. It is useless to insist on the importance which our discovery will possess when the means are found to render it universally applicable. The enormous consumption of madder in the printing of tissues, the large tracts of fertile soil made use of for its cultivation, are so many witnesses of the importance which a new trade would have, founded on the artificial preparation of alizarine by means of a material contained in the oil of coal tar."

It appears, according to further accounts from Berlin, that Messrs. Graeger and Liebermann, in order to obtain alizarine from anthracene (paranaphthalene), convert that hydrocarbon into alcohol, and the alcohol into an acid (lizaric acid and alizarine being synonymous), by acting upon the hydrocarbon with chlorine or bromine, and next effecting a double decomposition by means of acetate of potassa and caustic potassa; after which again an oxidising agent is made to act upon the alcohol so obtained. We think we may state that the gentlemen above named prefer the oxidising action of chlorate of potassa and hydrochloric acid.

RESEARCHES ON GASEOUS SPECTRA

IN RELATION TO THE

PHYSICAL CONSTITUTION OF THE SUN.*

BY DR. E. FRANKLAND, F.R.S., AND J. NORMAN LOCKYER, F.R.A.S.

THE authors have carefully studied the spectrum of hydrogen under varying conditions, with a view of detecting whether or not there existed a line in the orange, and to determine the cause to which the thickening of the line r is due. They failed to detect any line in the hydrogen spectrum near the line d . As regards the thickening of the line r , they have convinced themselves that the widening out is due to pressure, and not appreciably, if at all, to temperature *per se*. Having determined that the phenomena presented by the line r were dependent upon and indicated varying pressures, the authors were in position to determine the atmospheric pressure operating in a prominence, in which the red and green lines are nearly of equal width, and in the chromosphere, through which the green line gradually expands as the body of the sun is approached. With regard to the higher prominences, they have ample evidence that the gaseous medium of which they are composed, exists in a condition of excessive tenuity, and that at the lower surface of the chromosphere itself the pressure is very far below the pressure of the earth's atmosphere. The bulbous appearance of the line r may be taken to indicate violent consecutive currents, or local generations of heat, the condition of the chromosphere being doubtless one of the most intense action. According to the hypothesis based upon Kirchhoff's researches and examination of the solar spectrum, the photosphere itself is either solid or liquid, and is surrounded by an atmosphere composed of gases and the vapours of the substances incandescent in the photosphere. Instead of this compound atmosphere, the authors of these researches have found a gaseous envelope, by which nearly, or at all events mainly, the spectrum of hydrogen is given; while the tenuity of this incandescent atmosphere is such, that it is extremely improbable that any consider-

* Abstract of a paper presented to the Royal Society, February 11th, 1869.

able atmosphere, such as the corona has been imagined to indicate, lies outside of it. With regard to the photosphere itself, so far from being either a solid surface or a liquid ocean, that it is cloudy, or gaseous, or both, follows both from their observations and experiments.

ON THE REFRANGIBILITY OF THE BRILLIANT YELLOW RAY OF THE SOLAR ATMOSPHERE.

BY M. G. RAYET.

I HAVE lately been enabled to determine in a very exact manner the position of this brilliant line by means of a very dispersive spectroscope and a fine wire micrometer. By taking, as unity, the distance d' d'' , between the two lines of group d , the number 2.49 is found as equivalent to the distance between the brilliant line at d , and the most refrangible of the d rays. The probable error in this result is less than 0.03.

The brilliant yellow line corresponds to the division 1016.8 of the scale of the Kirchhoff spectrum. Adopting for length of wave of the lines d' and d'' 0.00059053 m.m., and 0.00058988 m.m., that of the brilliant line is 0.00058827 m.m. The yellow line may be seen upon the whole circumference of the solar disc quite as easily as the three lines of hydrogen: the incandescent gas to which it corresponds is therefore of the same character as hydrogen, one of the constituent elements of the solar atmosphere. At the point where the brilliant ray appears, no black line has yet been perceived.

The mode by which I have daily examined the solar atmosphere was as follows:—I employed an equatorial with an object glass, of a focal length of 5 metres, and which was diaphragmed down to 8 centimetres. The telescope was thus rendered quite achromatic, and the difference between the brilliancy of the image of the solar disc and that of its atmosphere was greatly reduced. At the principal focus, where the clear image of the sun fell, was placed the very narrow slit of a direct vision spectroscope; the astronomical telescope, which serves in the latter instrument to examine the spectrum, is movable around an axis which is parallel with the edges of the prism, and it is quite easy to keep only a small region of the spectrum within the field of vision, namely, that containing one of the brilliant lines. I have also placed between the object glass and the slit of the spectroscope a direct vision prism, itself preceded by a narrow slit. This arrangement is very advantageous as regards a clear view of the yellow line. In this case there is formed an imperfect image a little farther off than the principal focus of the object glass, and from this a determined colour is thrown upon the slit of the spectroscope.—*Comptes Rendus.*

ON NEW EXPLOSIVE POWDERS.

BY M. DESIGNOLLE.

(ABSTRACT.)

MANY improvements having lately been made in the art of war, and particularly in the adoption of breech-loading arms, the want has been felt of new powders to meet the requirements of the present artillery. This want has been supplied by M. Designolle, who has invented a new system of powders of which carbazotate or picrate of potash is the base. These powders are of four kinds—viz., a musket powder, gunpowder for short bore cannons, slow gunpowder for cannons with long

bore, and an explosive powder for torpedoes and projectiles destined for the undermining of fortifications. The principal advantages of these new powders are the following:—Increase of ballistic power without increase of explosive power; the base remaining the same, possibility of regulating and varying the effects between the limits of one to ten; also of regulating, at will, the rapidity of combustion of this powder, and of increasing the ballistic power without changing the mode of manufacture. Other advantages are—regularity in the manner of action; suppression of sulphur, and consequently of the vapours of sulphide of potassium and sulphuretted hydrogen; absence of action on metals and almost entire suppression of smoke. Into the explosive powders only two components enter—picrate of potash and nitrate of potash; the musket and gun powders contain carbon in addition to the above-named ingredients. To prepare these powders, the ingredients are beaten from three to six hours with a proportion of water varying from 6 to 14 per cent, according to the nature of the mixture; the powder is condensed by means of the hydraulic press, with a pressure of from 30,000 to 100,000 kilos., graining of the powder, and pressing and drying it according to the methods employed for the black powder. In order to increase the ballistic power, the relative proportion of picrate of potash in the mixture must be increased. For musket powder it has been proved that not more than 20 per cent of picrate of potash is required, while for gunpowders its proportion varies from 8 to 15 per cent. This component (picrate of potash) is of a beautiful golden yellow colour, and crystallises into prismatic needles possessing a brilliant reflection; it is insoluble in alcohol, but soluble in about 260 parts of water at 15 or 14 parts of boiling water. Heated with care it becomes orange red at a temperature of 300°, but, on cooling, it assumes its original colour. Heated to 310°, it detonates with violence. The researches of M. John Casthellaz on the action of nitric acid on phenic acid improved the method of manufacturing picric acid, and produced chemically pure picrate of potash at such a reasonable price that the new powders are not more expensive than ordinary black powder.

MM. Designolle and Casthellaz give the following proportions for preparing deflagrating mixtures with coloured flames:—

Golden fire	{ Picrate of ammonia	50
	{ Picrate of iron . . .	50
Green fire ..	{ Picrate of ammonia	48
	{ Nitrate of barytes	52
Red fire.....	{ Picrate of ammonia	54
	{ Nitrate of strontian	46

—*Bulletin de la Société d'Encouragement.*

ON THE IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

BY M. BERTHELOT.

(Concluded from Am. Repr., May, 1869, page 231.)

III. CARBON SEPARATED FROM ITS DIFFERENT COMBINATIONS.

I EXTRACTED carbon from its combinations with hydrogen, chlorine, sulphur, nitrogen, oxygen, boron, and metals, varying as much as possible the conditions of the separation.

1. *Hydrocarbon Combinations.*—These I decomposed

by heat alone, by the electric spark, and by chlorine, oxygen, &c.

Heat.—Carbides of hydrogen, decomposed by passing their vapour through a red-hot tube, yield amorphous carbon, which has a metallic brilliancy in that part which adheres to the sides of the tube, whilst the central portion is pulverable and soils paper; both will dissolve in the oxidising reagent, but the metallic portion being more coherent, will require a greater number of treatments. Charcoal furnished by benzenic carbides does not differ in this respect from the charcoal of other carbides—similar facts may be here remembered with respect to charcoal from retorts, wood charcoal, and coke.

The Electric Spark.—I have examined the carbon precipitated by this means in the decomposition of marsh gas; it consisted of amorphous carbon and a small quantity of graphite. I believe the amorphous carbon to be due to the proper decomposing action of heat, and the graphite to that of electricity.

Chlorine.—The carbon precipitated from marsh gas by this means was amorphous carbon, similar to that produced by heat.

Iodine and Iodhydric Acid.—Benzine, naphthaline, and several other carbides, heated to 280° for several days, yield a special charcoaly matter, interesting on account of the low temperature at which it is formed. The charcoaly matters contained in benzine and naphthaline both behave in the same manner. They are easily dissolved by an oxidising agent, and form a yellowish brown compound, very emulsionable, easily precipitated by the addition of a salt, and, in fact, nearer than any other to the state of graphitic oxides, without, however, being capable of total assimilation with them. The charcoal derived from benzine retains this property after being calcined to a white heat in hydrogen; but it does not then acquire the power of furnishing a true graphitic oxide.

Products obtained by oxidising benzenic charcoal with pure nitric acid were subjected to special examination; they are soluble in concentrated nitric acid, but if this be diluted with water, a brown resin is precipitated, whilst an analogous substance is suspended in solution. The first, when dried, becomes brown and fragile; it deflagrates after the manner of graphitic oxides, but contains nitro elements. On treating this insoluble resin with iodhydric acid at 280° , together with the soluble substance, the result was abundance of gaseous carbides and a few liquid carbides. The simultaneous contact of iodine and iodhydric acid at 280° does not then determine either the formation of graphite, or of a charcoal, transformable into graphite by calcination; but at a higher temperature it is otherwise. The charcoal obtained by the decomposition of iodhydric ether in a red-hot tube does, in fact, contain a considerable quantity of graphite, transformable by oxidation into an oxide analogous to that of electric graphite. With regard to carbon in formation at this temperature, iodine presents the same modifying power by which it so easily changes ordinary into red phosphorus, and soluble into insoluble sulphur.

These conditions of carbon and sulphur are precisely those which are affected by the same elements obtained by the decomposition of their chlorinated compounds.

Oxygen.—Lampblack represents carbon precipitated by incomplete combustion, in which heat and oxidation concur; it has been previously shown to consist of amorphous carbon, with a trace of graphite. The first

I attribute to the action of heat, the second to oxidation affected at a high temperature.

I have also examined the charcoaly matter produced by the slow combustion of acetylide of copper at the ordinary temperature; it is entirely dissolved by oxidation.*

2. *Chloride of Carbon.*—Upon decomposing the vapour of perchloride of carbon, C_2Cl_4 , in a red tube, the charcoaly matter obtained was found to be a mixture of amorphous carbon with a considerable quantity of graphite. The chloride of carbon does not, therefore, furnish the same carbon as marsh gas, notwithstanding the analogy of the formulæ C_2H_4 and C_2Cl_4 .

3. *Sulphide of Carbon.*—On being decomposed in a red tube, furnishes carbon in thin coherent plates. This carbon contains much graphite, but does not soil paper.

4. *Nitride of Carbon.*—Cyanogen decomposed by the spark only furnishes amorphous carbon with a trace of graphite; the latter I attribute to the influence of the spark.

5. *Carbonic Acid.*—Carbonate of soda is decomposed by heating with phosphorus. The carbon thus obtained is black and light, and is not attacked by iodhydric acid at 280° . It dissolves by oxidation, leaving a small quantity of graphitic oxide. It may therefore be considered as a mixture of amorphous carbon and graphite.

I also caused sodium to react at a red heat on carbonate of soda; on again taking up the mass with water, the whole dissolves, except a small quantity of carbon, consisting principally of graphite.

6. *Carbide of Boron.*—Carbon is extracted from adamantine boron, by treating it with a current of dry chlorine at red heat. This was effected at two different temperatures—viz., at one inferior to that at which glass is softened, and at one approaching that at which porcelain fuses. In both cases the carbon consisted of graphite, containing no traces of diamond, and transformable into graphitic oxide. The sole difference between the two experiments was that the graphite prepared at dull red heat was amorphous, while that produced at white heat was in hexagonal crystals.

The last-named carbon was deposited partially some distance from where the boron was first placed; this was probably due to the temporary formation of a double chloride of carbon and of boron. Some of the crystals, when examined under the microscope, present the appearance of truncated octahedrons, from the irregular development of their edges; nevertheless, when closely looked at, their form, together with their transformation into graphitic oxide, will remove all doubt.

7. *Carbide of Iron.*—The carbon combined with iron is extracted by two processes—viz., by the action of chlorine at a dull red heat, and with bichloride of mercury. The carbon thus obtained consists in both cases of a mixture of amorphous carbon with a small quantity of graphite. It appears, therefore, that carbon separated from carbides of hydrogen by the action of heat does not contain graphite; while carbon separated from sulphide and chloride of carbon by the action of heat, and from boron by the action of chlorine, contains a considerable proportion of it. Carbon separated from

* The acetylide of copper was prepared with acetylene formed under the influence of the electric arc and by means of its elements. I was able to separate, by means of chlorhydric acid, &c., the charcoaly matter which had formed, after keeping several years.

carbonic acid (united with soda) cannot be obtained in a condition equally simple; except in one case, this carbon, isolated either by phosphorus or sodium, also contains a certain proportion of graphite. It is the same with carbon separated from organic compounds by incomplete combustion—that is, by the concurrence of heat and oxidation.

The result of these observations is, that carbon, when separated from hydrogenised combinations, takes the condition of amorphous carbon; whilst that derived from chlorine, sulphur, boron, and perhaps oxygen, inclines to the state of graphitic carbon. Amorphous and graphitic carbons would therefore appear to represent, not different conditions of the carbon itself, but certain polymeric states corresponding with that element.—*Comptes Rendus*.

ON THE WASHING OF PRECIPITATES.*

BY PROFESSOR R. BUNSEN.

In the process of filtration as hitherto conducted, the time required is so long and the quantity of wash-water needed so great that some simplification of this continually recurring operation is in the highest degree desirable. The following method, which depends, not upon the removal of the impurity by simple attenuation, but upon its displacement by forcing the wash-water through the precipitate, appears to me to combine all the requisite conditions and therefore to satisfy the need.

The rapidity with which a liquid filters depends, *ceteris paribus*, upon the difference which exists between the pressure upon its upper and lower surfaces. Supposing the filter to consist of a solid substance, the pores of which suffer no alteration by pressure or by any other influence, then the volume of liquid filtered in the unit of time is nearly proportional to the difference in pressure: this is clearly shown by the following experiment, made with pure water and a filter consisting of a thin plate of artificial pumice-stone. The thin plate of pumice was hermetically fastened into a funnel consisting of a graduated cylindrical glass vessel, the lower end of which was connected with a large thick flask by means of a tightly fitting caoutchouc cork. The pressure in the flask was then reduced by rarefying the air by means of a method to be described upon another occasion; and for each difference of pressure, p , measured by a mercury column, the number of seconds, t , was observed which a given quantity of water occupied in passing through the filter. The following are the results:—

p .	I.	
	t .	pl .
metre.	"	"
0.179.....	91.7.....	16.4
0.190.....	81.0.....	15.4
0.282.....	52.9.....	14.9
0.472.....	33.0.....	15.6

In the ordinary process of filtration, p on the average amounts to no more than 0.004 to 0.008 metre. The advantage gained, therefore, is easily perceived when we can succeed by some simple practicable and easily attainable method in multiplying this difference in pressure one or two hundred times, or, say, to an entire

atmosphere, without running any risk of breaking the filter. The solution of this problem is very easy: an ordinary glass funnel has only to be so arranged that the filter can be completely adjusted to its sides even to the very apex of the cone. For this purpose a glass funnel is chosen possessing an angle of 60°, or as nearly 60° as possible, the walls of which must be completely free from inequalities of every description; and into it is placed a second funnel made of exceedingly thin platinum foil, and the sides of which possess exactly the same inclination as those of the glass funnel. An ordinary paper filter is then introduced into this compound funnel in the usual manner; when carefully moistened, and so adjusted that no air-bubbles are visible between it and the glass, this filter, when filled with a liquid, will support the pressure of an extra atmosphere without ever breaking.

The platinum funnel is easily made from thin platinum-foil in the following manner:—In the carefully chosen glass funnel is placed a *perfectly accurately fitting* filter made of writing paper; this is kept in position by dropping a little melted sealing-wax between its upper edge and the glass; the paper is next saturated with oil and filled with liquid plaster of Paris, and before the mixture solidifies a small wooden handle is placed in the centre. After an hour or so the plaster cone with the adhering paper filter can be withdrawn by means of the handle from the funnel, to which it accurately corresponds. The paper on the outside of the cone is again covered with oil, and the whole carefully inserted into liquid plaster of Paris contained in a small crucible 4 or 5 centims. in height. After the mixture has solidified, the cone may be easily withdrawn; the adhering paper filter is then detached, and any small pieces of paper still remaining removed by gently rubbing with the finger. In this manner a solid cone is obtained accurately fitting into a hollow cone, and of which the angle of inclination perfectly corresponds with that of the glass funnel.

Fig. 1 represents the cones. By their help the small platinum funnel is made. A piece of platinum (Fig. 2 shows the natural size) is cut from foil of such a thickness that one square centimetre weighs about 0.154 grm., and from the centre, a , a vertical incision is made by the scissors to the edge, c, b, d . The small piece of foil is next rendered pliable by being heated to redness, and is placed upon the solid cone in such a manner that its centre, a , touches the apex of the latter; the sides, a, b, d , are then closely pressed upon the plaster, and the remaining portion of the platinum wrapped as equally and as closely as possible around the cone. On again heating the foil to redness, pressing it once more upon the cone, and inserting the whole into the hollow cone and turning it round once or twice under a gentle pressure, the proper shape is completed. The platinum funnel, which should not allow of the transmission of light through its extreme point, even now possesses such stability that it may be immediately employed for any purpose. If desired, it may be made still stronger by soldering down the overlapping portion in one spot only to the upper edge of the foil, by means of a grain or two of gold and borax; in general, however, this precaution is unnecessary. If the shape has in any degree altered during this latter process, it is simply necessary to drop the platinum funnel into the hollow cone and then to insert the solid cone, when, by one or two turns of the latter, the proper form may be immediately restored. The platinum funnel is placed in the bottom of the glass funnel, the dry paper filter then

* We are kindly permitted by the proprietors of the *Philosophical Magazine* to copy these portions of Professor Bunsen's paper from their number for January, 1869, where the complete paper may be found.

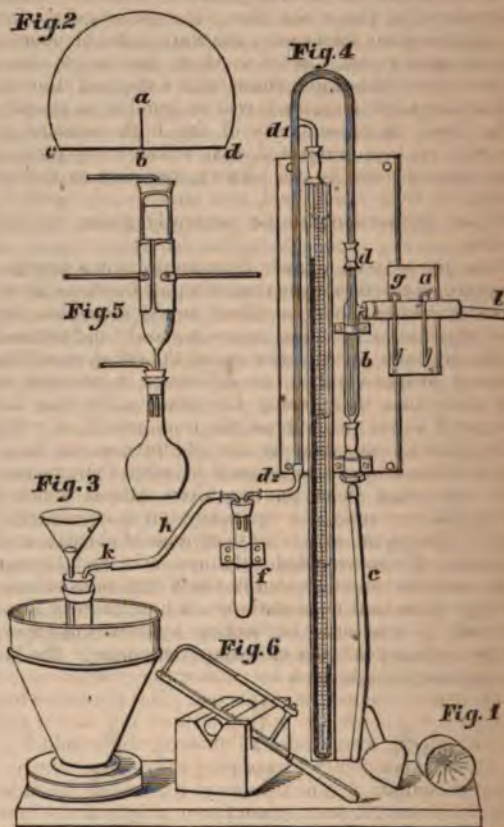
introduced in the ordinary manner, moistened, and freed from all adhering air-bubbles by pressure with the finger. A filter so arranged and in perfect contact with the glass, when filled with a liquid, will support the pressure of an entire atmosphere without the least danger of breaking; and the interspace between the folds of the platinum-foil is perfectly sufficient to allow of the passage of a continuous stream of water.

In order to be able to produce the additional pressure of an atmosphere, the filtered liquid is received in a strong glass flask instead of in beakers.* This flask is closed by means of a doubly perforated caoutchouc cork, through one of the holes of which the neck of the glass funnel is passed to a depth of from 5 to 8 centimetres (fig. 3); through the other is fitted a narrow tube open at both ends, the lower end of which is brought *exactly to the level of the lower surface of the cork*, to the other is adapted the caoutchouc tube connected with the apparatus (fig. 4) destined to produce the requisite difference in pressure: this apparatus will be described immediately. The flasks are placed in a metallic or porcelain vessel (fig. 3), in the conical contraction of which several strips of cloth are fastened. This method of supporting the flask has the advantage that, in one and the same vessel, flasks varying in size from 0.5 to 2.5 litres stand equally well, and that, by simply laying a cloth over the mouth of the vessel, the consequences of an explosion (which through inexperience or carelessness is possible) are rendered harmless.

It is impossible to employ any of the air-pumps at present in use to create the difference in pressure, since the filtrate not unfrequently contains chlorine, sulphurous acid, hydric sulphide, and other substances which would act injuriously upon the metallic portions of these instruments. I therefore employ a *water* air-pump constructed on the principle of Sprengel's mercury-pump, and which appears to me preferable to all other forms of air-pump for chemical purposes, since it effects a rarefaction to within 6 or 12 millimetres pressure of mercury.

Fig. 4 shows the arrangement of this pump. On opening the pinchcock, *a*, water flows from the tube, *l*, into the enlarged glass vessel, *b*, and thence down the leaden pipe, *c*. This pipe has a diameter of about 8 millims., and extends downwards to a depth of 30 or 40 feet, and ends in a sewer or other arrangement serving to convey the water away. The lower end of the tube, *d*, possesses a narrow opening; it is hermetically sealed into the wider tube, *b*, and reaches nearly to the bottom of the latter. A manometer is attached to the upper continuation of this tube, *d*, by means of a side tube at *d*₁; at *d*₂ is attached a strong thick caoutchouc tube possessing an internal diameter of 5 millims. and an external diameter of 12 millims.; this leads to the flask which is to be rendered vacuum, and is connected with it by means of the short narrowed tube, *k*. Between the air-pump and the flask is placed the small thick glass vessel, *f*, in which, when one washes with hot water, the steam which may be carried over is condensed. All the caoutchouc joinings are made with very thick tubing, the internal diameter of which amounts to about 5 millims., the external diameter to about 17 millims. The entire arrangement is screwed down upon a board fastened to the wall, in such a manner that each separate piece of the apparatus is held by a single fastening only, in order to prevent the

tubes being strained and broken by the possible warping of the board. On releasing the pinchcock, *a*, water flows from the conduit, *l*, down the tube, *c*, to a depth of more than 30 feet, carrying with it the air which it sucks through the small opening of the tube, *d*, in the form of a continuous stream of bubbles. No advantage is gained by increasing the rapidity of the flow, since the friction exerted by the water upon the sides of the leaden pipe acts directly as a counter pressure, and a comparatively small increase in the rapidity of the flow is accompanied by a great increase in the amount of this friction. Accordingly, at *g* is a second pinchcock, by which the stream can be once for all so regulated that, on completely opening the cock, *a*, the friction, on account of the diminished rate of flow, is rendered sufficiently small to allow of the maximum degree of rarefaction. Such an apparatus, when properly regulated once for all by means of the cock, *g*, exhausts in a comparatively short time the largest vessels to within a pressure of mercury equal to the tension of aqueous vapour at the temperature possessed by the stream.*



The tension exerted by the water-stream in my laboratory, in which six of these pumps are used, amounts to about 7 millims. in winter and 10 millims. in summer. The filtration is made in the following manner:—The flask standing in the metallic or porcelain vessel (fig. 3) is connected by means of the slightly drawn-out tube, *k*, with the caoutchouc tube, *h*, attached to the pump,

* These flasks must be somewhat thicker than those ordinarily used, in order to prevent the possibility of their giving way under the atmospheric pressure.

* The time required to obtain the above degree of exhaustion in a flask of from 1 to 3 litres capacity ranges from 6 to 10 minutes; the quantity of water necessary amounts to about 40 or 50 litres.

the cock, *a*, having been previously opened and the properly fitted moistened filter filled with the liquid to be filtered. As usual, the clear supernatant fluid is first poured upon the filter; in a moment or two the filtrate runs through in a continuous stream, often so rapidly that one must hasten to keep up the supply of liquid, since it is advisable to maintain the filter as full as possible. After the precipitate has been entirely transferred, the filtrate passes through, drop by drop, and the manometer not unfrequently now shows a pressure of an extra atmosphere. The filter may be filled (in fact, this is to be recommended) with the precipitate to within a millimetre of its edge, since the precipitate, in consequence of the high pressure to which it is subjected, becomes squeezed into a thin layer, broken up by innumerable fissures. As soon as the liquid has passed through, and the first traces of this breaking up become evident, the precipitate will be found to have been so firmly pressed upon the paper, that, on cautiously pouring water over it, it remains completely undisturbed. The washing is effected by carefully pouring water down the side of the funnel to within a centimetre above the rim of the filter: the washing-flask for this purpose is not applicable; the water must be poured from an open vessel. After the filter has in this manner been replenished four times with water and allowed to drain for a few minutes, it will be found to be already so far dried, in consequence of the high pressure to which it has been subjected, that without any further desiccation it may be withdrawn, together with the precipitate, from the funnel, and immediately ignited, with the precautions to be presently given, in the crucible.

If the porosity of a paper filter containing a precipitate were as unalterable as that of a pumice-stone filter, the experiments above described would show that the times required for filtration, according to the old method on the one hand, and the new one on the other, would be inversely proportional to the difference in pressure in each case; that is, by using the pump under the full pressure of about 740 millims., the time needed to wash a precipitate, occupying by the old process an hour, would at the utmost not amount to more than 30 seconds. In using these pumice filters (about which I will speak presently) to drain crystals from adhering mother-liquors, or, say, to wash crystals of chromic acid by means of concentrated sulphuric acid and fuming nitric acid, the time occupied in the filtration is scarcely longer than that needed to pour a liquid slowly from one vessel to another. In filtering by means of paper, the precipitate gradually closes up the pores of the filter, and accordingly such an extraordinary acceleration as this can no longer be expected. But the following examples will show the saving of time and labour the method effects, even under all unfavourable conditions. For these experiments I have purposely chosen the hydrated chromium sesquioxide, since it is one of the most difficult of precipitates to wash thoroughly. A solution of chromium chloride was prepared by acting with fuming hydrochloric acid upon potassium dichromate; and by means of a measuring vessel, which allowed the amount of chromium to be estimated to within 0.0001 grm., successive portions of the liquid were withdrawn, and the chromium oxide contained in them precipitated with the usual precautions by ammonia. The volume of liquid, the quantity of ammonia employed, the time occupied in boiling and in permitting the precipitate to settle, the angle of inclination possessed by the funnel, and the size of the filter were the same in all the exper-

iments. All the precipitates were washed with hot water, and, after burning the filter, ignited over the blowpipe for a few minutes; in weighing, the platinum crucible was tared by one of about equal weight, and the position of equilibrium of the beam determined by vibrations.

In washing, by means of decantation, in the ordinary manner, the amounts of chromium sesquioxide found were as follows:—

	grms.
II. 0.2458, after 5 decantations, washed to the 50,000th part.	
III. 0.2452, after 7 decantations, washed to the 200,000th part.	
IV. 0.2443, after 10 decantations, washed to the 100,000,000th part.	

0.2451 mean.

By the use of the pump:—

	grms.
V. 0.2435, after 5 additions of water.	
VI. 0.2434, " 4 " "	
VII. 0.2432, " 3 " "	
VIII. 0.2435, " 2 " "	
IX. 0.2439, " 1 " "	
X. 0.2439, " 1 " "	

0.2436 mean.

Hence the probable amount of chromium sesquioxide contained in the solution, according to the experiments with the pump, was 0.2436 grm.; according to the old method of decantation it was somewhat higher, namely, 0.2451 grm. This excess of 1.5 milligramme shows that the adhesion of the soluble matters to the precipitate and to the filter is, in consequence of the greater pressure, more easily overcome in the new method than in the customary process; it follows, therefore, that we can obtain a more complete washing by the new method than by the old. The old process of decantation required 108 minutes and 1050 c.c. of water to effect a washing to the 50,000th part; the new, on the contrary, only 12 to 14 minutes, and not more than 39 to 41 c.c. of wash-water. If a precipitate be heated in a platinum crucible immediately after filtration by the older process, a portion will inevitably be projected out of the crucible. Hitherto, therefore, it has been necessary to dry the filter and precipitate before ignition. Now to dry a quantity of hydrated chromium sesquioxide containing 0.2436 grm. Cr_2O_3 in a water-bath at 100°C . requires at least 5 hours; and, moreover, bringing the dried precipitate into the crucible, burning the filter, and gradually igniting the mass is in the highest degree tedious and troublesome. All this expenditure of time and labour may be saved by employing the new method. By its means a precipitate is as completely dried upon the filter in from 1 to 5 minutes as if it had been exposed from 5 to 8 hours in a drying-chamber; and it can immediately, filter and all, be thrown into a platinum or porcelain crucible and ignited without the slightest fear of its spurting. By operating in the following manner the filter burns quietly without flame or smoke; this phenomenon, although remarkable, easily admits of an explanation. The portion of filter-paper free from precipitate is tightly wrapped round the remainder of the filter in such a manner that the precipitate is enveloped in from four to six folds of clean paper. The whole is then dropped into the platinum or porcelain crucible lying obliquely upon a triangle over the lamp, and pushed down against its sides with the finger. The cover is

then supported against the mouth of the crucible in the ordinary way, and the ignition commenced by heating the portion of the crucible in contact with the cover. When the flame has the proper size and position, the filter carbonises quietly without any appearance of flame or considerable amount of smoke. When the carbonisation proceeds too slowly, the flame is moved a little towards the bottom of the crucible. After some time the precipitate appears to be surrounded only by an extremely thin envelope of carbon, possessing exactly the form (of course diminished in size) of the original filter; the flame is then increased, and the crucible maintained at a bright red heat until the carbon contained in this envelope is consumed. The combustion proceeds so quietly that the resulting ash surrounding the precipitate possesses, even to the smallest fold, the exact form of the original filter. If the ash shows here and there a dark colour, it is simply necessary to heat the crucible over the blowpipe for a few minutes to effect the complete removal of the trace of carbon. This method of burning a filter is extremely convenient and accurate; it is only necessary to give a little attention at first to the slow carbonisation of the paper, after which the further progress of the operation may be left to itself.

Gelatinous, finely divided, granular, and crystalline precipitates, such as alumina, calcium oxalate, barium sulphate, silica, magnesium ammonium phosphate, &c., may with equal facility be treated in this manner; so that even in this particular the work, in comparison with the method generally adopted, is considerably shortened and simplified.

From the above experiments it appears that the time necessary to filter and dry a quantity of chromium sesquioxide, hitherto requiring about 7 hours, is reduced by the new method to 13 minutes. This saving of time is, moreover, proportionately greater in the case of precipitates more easily filtered than hydrated chromium sesquioxide. Particularly is this so in separating a finely suspended precipitate from a large volume of water. Under these circumstances the clear fluid runs through the filter in a continuous stream, so rapidly that it is scarcely possible to maintain the supply; the entire operation, in fact, requires scarcely more time than that necessary to pour a liquid from one vessel to another. Filtration, therefore, may be effected as quickly through the smallest as through the largest filter. Moreover, the exceedingly small amount of water required to wash a precipitate completely renders unnecessary the tedious evaporations which, by the older method, are almost inevitable when the filtrate is needed for a further separation. Thus the introduction of impurities from the action of the liquid upon the dish in the course of evaporation is prevented; and also the loss due to the slight solubility of the greater number of precipitates in the wash-water is reduced to a minimum. Supposing we had to analyse an alkaline chromate in which the quantity of chromic acid is equivalent to 0.2436 gm. chromic sesquioxide, as in the above-described experiments, then to determine the proportion of alkali we should, by using the older method, require the preliminary evaporation of about 1050 c.c. of liquid; by the new method the evaporation of 40 c.c. only is necessary. Now by employing the best form of water-bath, i.e. one possessing a constant water level, such as is used in my laboratory, it is possible, under favourable circumstances, to evaporate in a porcelain dish 1 c.c. of water in 27 seconds. Consequently the evaporation of the filtrate obtained by the older method would occupy about 8 hours, whilst by the new 18 minutes only are required.

The total length of time needed to filter the chromium sesquioxide, wash and dry the precipitate, and evaporate the filtrate is reduced, therefore, from 14 or 15 hours to about 32 minutes.

The experience I have subsequently gained in my laboratory, where the method has been in general use for the last nine months, fully confirms the above results. It has shown that, on the average, three or four analyses can now be made in the time formerly demanded by a single one.

Another and an inestimable advantage springs from the peculiar condition of a precipitate filtered by this method. It not unfrequently happens, even in the hands of experienced manipulators, in consequence of the agitation it is necessary to give to the contents of the filter to effect their complete washing, that the surface of the filter becomes injured and torn, so that the precipitate becomes mixed with filaments of paper; this is particularly the case in using hot water. Supposing the precipitate to consist of mixed hydrates of the sesquioxides (for example, iron and alumina), it will be found, on redissolving in an acid, that the filaments, like tartaric acid, prevent the complete separation of these substances by subsequent precipitation; thus the alumina will contain iron, and on precipitation by means of ammonium sulphide will be coloured black. On the other hand, by employing the new method the precipitate coheres so firmly that the introduction of this source of error is impossible, even by using common grey filter-paper. The most gelatinous precipitates, as hydrated ferric oxide, alumina, &c., adhere to the filter in a thin coherent layer, and may be removed, piece after piece, so completely that the paper remains perfectly clean and white. The advantage thus gained, where it is necessary to transfer mixed precipitates to another vessel in order to effect their subsequent separation, is evident.

The filter-pump, moreover, is exceedingly serviceable in separating precipitates or crystals from syrupy mother-liquors. Thus honey-sugar may be so completely separated from the thick viscid liquid in which it forms, by a filter of coarse grey paper, that it remains only slightly coloured, and by a single crystallisation from alcohol may be obtained in small white shining needles. And since the bulk of the moist precipitates, particularly that of the more gelatinous, is so much diminished under the high pressure, the precipitate only occupying one-third to one-sixth of its bulk under ordinary circumstances, a filter of one-third to one-sixth of the size usually employed may be taken, and thus the amount of ash proportionately lessened.

As the water air-pump suffers no injury from the presence of corrosive vapours or gases, we can equally well employ it to filter liquids containing nitrous acid, sulphurous acid, fuming nitric acid, chlorine, bromine, volatile chlorides, &c. In such cases I use a peculiar filtering arrangement, consisting of a cylindrical glass vessel, the lower end of which is drawn out before the blow-pipe to the form shown in fig. 5; in this drawn-out portion a thin plate, 1 or 2 m.m. in thickness, of artificial pumice, such as is used by polishers, is packed water-tight by means of asbestos. This apparatus is arranged for the purpose required exactly as the funnel in the method of filtration by pressure above described. In order to have a number of these filters in readiness, a pumice-stone cylinder of the required diameter is turned in a lathe, and then the thin plates sawn off by means of a small hand-saw in the small wooden support shown in fig. 6. The upper surfaces

of the plates may afterwards be rendered perfectly even by a coarse file.

By the aid of these pumice-stone filters many chemical products may be made, the preparation of which has hitherto been almost impossible. For the sake of example, I take the preparation of pure dry chromic anhydride; in an hour it is easily possible to filter, wash, and dry crystals of this substance an inch in length. A solution of 2 parts of potassium dichromate in 20 parts of water mixed with 10 parts of concentrated sulphuric acid, deposits, after standing about 24 hours, numerous brilliant needles of chromic anhydride. These may be drained from adhering mother-liquor upon the pumice filter by means of the pump, and in a few minutes completely washed by a small quantity of fuming nitric acid free from nitrous acid. A covering of tolerably strong sheet copper provided with two arms, as shown in fig. 5, is then placed round the tube; by hanging lamps upon the arms the tube may be readily heated to about 60° or 80° C.; and by connecting a chloride-of-calcium tube with the upper end of the glass vessel, a current of dry air may be drawn through the apparatus by means of the pump, and thus, in a comparatively short time, large and brilliant crystals of chromic anhydride, perfectly dry and free from all impurity, may be easily obtained.

A single pump of the above description costs, including the leaden piping, about 8 thalers (24 shillings); and experience has shown that five or six are amply sufficient for a laboratory of fifty or sixty students. The apparatus, as may readily be seen, can be applied in the operation of evaporating *in vacuo*.

I believe that the above-described water air-pump will soon become an indispensable piece of apparatus in chemical laboratories. It not only serves as the most convenient method of producing the differences in pressure required to accelerate the process of filtration, and of obtaining the necessary vacuum for evaporation; it is equally adapted for purposes to which neither the mercury nor the ordinary pumps are in any way applicable. By its aid it is possible to calibrate a thermometer with the greatest accuracy, and to estimate the vapour-tension of such corrosive bodies as bromine, chromyl dichloride, &c., by the simplest method possible, in which the necessary operations require scarcely more time than an ordinary determination of a boiling-point.

I purpose returning to these applications of the instrument in a future communication.

INFLUENCE OF THE OXIDES OF CHROMIUM AND TITANIUM ON THE COMPOSITION OF PIG-IRON.

BY AUG. A. AND S. DANA HAYES,
ASSAYERS TO STATE OF MASSACHUSETTS.

WITHIN the last four years we have been frequently employed in chemical investigations of the altered characters of some pig-irons, which resulted apparently under the usual circumstances in the reduction of uniform ore.

In these cases the amount of carbon united with the iron had been diminished, without the introduction of other matter, in quantity sufficient to influence a change in this connection, and generally no variation in the composition of the ore was known or suspected. We had analysed the ores in some of the beds in former

years and regarded them as well adapted to the production of pig-iron of good quality; but in pursuing the research we were convinced that the change in quality of iron could be traced to altered composition in the ore of part of the beds used for supplying the furnaces.

The correctness of this view was confirmed by our analyses of many iron ores, in some of which we found the oxides of chromium or titanium existing where they were not indicated and connected with the ore in beds which have been considered as pure iron ores.

Both the oxide of chromium and oxide of titanium seem to act in the furnace or the crucible in a way to withdraw a portion of the carbon, or prevent that true union of carbon with a portion of the iron, which constitutes grey pig-iron, without the metals of these oxides really alloying with the iron and thus indicating the cause of change. We have analysed samples of pig-iron where the alloys of chromium or titanium existed in the pigs, and where the oxides accompanied the ores in the beds, but we were not prepared to find an influence exerted on the quality of the pig metal without the refractory metals forming a part of the composition.

The occurrence of oxide of manganese with iron ore is common, and titanium compounds are often found in both magnetic and brown iron ores, as insoluble substances, in small proportions, and these compounds combine with and are removed by the fluxes without injury to the pig metal. These compounds of titanium are the cause of the often superb blue colour of the cinder, produced under varying conditions of glassy or stony character, and must be carefully distinguished from those we regard as more detrimental in their influence on the metal.

In a number of analyses of iron ores we had found both oxide of chromium and oxide of titanium in a state rendering them soluble in diluted acids, and in a condition to escape detection in the ordinary modes of analysis. Both magnetic and brown iron ores have been found to contain either oxide of chromium or oxide of titanium in this soluble state. Among the samples from contiguous beds, this diversity in composition made by the presence of some oxide of chromium or oxide of titanium existed; and while the bulk of a bed of ore was pure, continuations of the bed or associated ore yielded notable weights of oxide of chromium or oxide of titanium in the different samples.

The suggestion we would make to the iron-master in view of these facts, is the possibility of the quality of the pig metals in anomalous cases being greatly influenced by the admixture of some ore containing the oxides of chromium or titanium with the basis ore of good quality. This may take place by the main bed being crossed by veins of mixed ore, or by the workings passing into contiguous beds where one kind of ore is used. In other cases, where the iron the master can gain a great advantage arising from mixing ores, one of the kinds may contain the contaminating oxides and injure the iron.

We subjoin some results of analyses, showing the proportion of oxide of chromium to the metallic iron contained in the ores:—

1st. Magnetic ore—iron, 49; oxide of chromium, 1.40. 2nd. Haematite ore—iron, 42.47; oxide of chromium, 1.60. 3rd. Brown Massive ore—iron, 54.32; oxide of chromium, 1.90. 4th. Same—iron, 46.70; oxide of chromium, 1.04.

More traces have been discovered in some cases, while in other instances a larger proportion of chromium formed an alloy with the iron produced from the ore.—*Scientific American*.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

BY J. NORMAN LOCKYER.*

No. III.

In a former paper† the author stated that Dr. Frankland and himself had searched without success for the known third line of hydrogen in the spectrum of the chromosphere. He has now discovered that the position of the third line is at 2796 of Kirchhoff's scale. The author assumes that the darkening of the limb is due to the general absorption of the chromosphere, and therefore it follows:—

1. That the additional selective absorption near the limb is extremely probable.
2. That the hydrogen Fraunhofer lines indicating the absorption of the outer shell of the chromosphere will vary somewhat in thickness: this he found to be the case to a certain extent.
3. That it is not probable that the prominences will be visible on the sun's disc.

On the 20th of February a spot was observed in which the general absorption was so great that the several lines could only be distinguished with difficulty, except in the very brightest region, which is ascribed to the greater length of the absorbing medium in the spot itself in the line of sight when the spot is observed near the limit instead of the centre of the disc.

Mr. Lockyer has succeeded in adding magnesium and barium to the material (sodium) to which he referred in paper No. 1 (published in 1866). He no longer regards a spot simply as a cavity, but as a place in which principally the vapours of sodium, barium, and magnesium occupy a lower position than they do ordinarily in the photosphere. It therefore follows—

1. The lines of sodium, magnesium, and barium, when observed in a spot, are thicker than their usual Fraunhofer lines.
2. The lines of sodium, magnesium, and barium, when observed in the chromosphere, are thinner than their usual Fraunhofer lines.

These facts give additional evidence that a spot is the seat of a downrush—a downrush to a region, as we now know, where the selective absorption of the upper strata is different from what it would be, and indeed is elsewhere at a higher level.

The author thinks there are two causes for the darkening of a spot, viz.:—

1. The general absorption of the chromosphere thicker here than elsewhere, as the spot is a cavity.
2. The greater selective absorption of the lower sodium, barium, magnesium stratum, as the surface of its last layer is below the ordinary level.

Mr. Lockyer is waiting to make observations with the large Stenheil spectroscope to finally test the accuracy of the valuable suggestion of Messrs. De La Rue, Stewart, and Loewy, in their "Researches on Solar Physics," that if the photosphere of the sun be the condensation of gaseous matter, the plane may be subject to periodical elevations and depressions and that at the epoch of minimum sun-spot the plane might be uplifted very high in the

solar atmosphere, so that there is comparatively little cold-absorbing atmosphere above it, and therefore great difficulty in forming a spot.

With a rapidly oscillating slit the author was not satisfied with his results, but on hearing that Mr. Huggins had succeeded in seeing the form of the solar protuberances, by using absorbing media and a wide slit, he was led to try the wide slit without the absorptive media, and in the following words he describes the results:—"The solar and atmospheric spectra being hidden, and the wide image of the slit alone being visible, the telescope or slit is moved slowly, and the strange shadow-forms flit past. Here one is reminded by the fleecy, infinitely delicate cloud-films of an English hedge-row with luxuriant elms; here of a densely interwoven tropical forest, the intimately interwoven branches threading in all directions, the prominences generally expanding as they mount upwards, and changing slowly, almost, indeed, imperceptibly. By this method the smallest details of the prominences and of the chromosphere itself are rendered perfectly visible and easy of observation."

In an addendum dated March 17th, the author states that more favourable weather had enabled him to continue his researches in reference to his method for viewing the prominences, and to view the injection of sodium, magnesium, &c., into the chromosphere. He thinks that in time it will be possible to see the prominences as they really are seen in an eclipse by constructing a rapidly revolving wheel with red, green, and violet glass of the required absorptions, in which the percentages of light of each colour may be regulated. On the 14th of March, with a tangential slit, a fine dense prominence near the sun's equator on the eastern limb was observed.

ON THE

EXAMINATION OF THE "FLAME" OF THE BESSEMER CONVERTER.*

BY THOMAS ROWAN.

THE Bessemer process for the manufacture of steel is now among the most important of our metallurgical operations. On account of its comparatively recent introduction among established industries, it affords an ample field for scientific investigation, and there is no feature of the process at once so interesting and important as that of the flame which issues from the "converting vessel."

The success of a "blow" undoubtedly depends on the accuracy and completeness of many details, but of them all, the most important is to know and catch that moment in the existence of the flame when the carbon in the iron has yielded its last trace to the oxygen of the air.

If a charge is "over-blown"—that is, if it be subjected to the action of the air for too long a period, or if it be "under-blown"—that is, if the admission of air is stopped before the proper chemical action has been completed, the steel will be found to be defective in proportion to its unskilful treatment.

The flame issuing from the converter is the index of these changes which the molten mass of metal is undergoing during the process; but the exact moment of decarburisation is often, from a variety of causes, difficult to determine.

* of a paper presented to the Royal Society, March 4th, 1869, *News*, vol. xix. p. 158 (*Am. Repr.*, June, 1869, page 278).

* Read at the meeting of the Chemical Section of the Glasgow Philosophical Society, March 29, 1869.

It is for these reasons that the examination of the flame forms the point of attraction of the process; and I have thought it might not be uninteresting to the members of this Society to describe to them the general appearance which this flame presents to the eye, and some experiments which my brother has made with the spectroscope and with coloured glasses, for the purpose of more readily determining that critical period or "change" in the flame which I have spoken of. The success of these latter experiments has enabled him to obtain the object for which they were commenced; and he has designed an instrument, which I shall describe hereafter, by which the change in the flame is more easily determined.

1st. The General Appearances of the Flame to the Eye.

When the vessel is first turned up, a shower of brilliant sparks is ejected, owing to the force of the blast reaching first a thin layer of metal as the vessel slowly swings round to the vertical position.

From 0 to 3 or 4 minutes.—When the full head of metal is over the blast, at first, for three or four minutes, there is scarcely any flame, only a current of very hot gases and very numerous sparks.

From 3 or 4 to 5 or 6 minutes.—Gradually a small pointed flame appears in the centre of the sparks, and this quickly increases in size, without gaining much brilliancy for two or three minutes.

From 5 or 6 to 9 or 10 minutes. During the next period of four or five minutes the flame is very unsteady, both in size and in position, and its oscillations are accompanied by hollow sounds, as of reports or explosions in the interior of the converter.

From 9 or 10 to 11 or 12 minutes.—Streaks, or flashes of brighter flame now shoot up through this comparatively non-luminous flame, and, within one or two minutes, give place to a continuous stream of dense and brilliant fire, which rushes far up the chimney and illuminates the entire building, often casting the shadows of the cranes, &c., against the windows through which the sun is shining.

From 11 or 12 to 15 or 16 minutes.—This flame gradually becomes thinner and more transparent, without losing any of its brilliancy during the six or seven minutes of the blow which generally remain, until it suddenly (preceded, however, by a few hollow and peculiar sounds from the interior of the vessel) loses its brilliancy and much of its size, and drops down, within about half a minute, to about the size it had reached at about five minutes of the blow; this flame, however, being more dense and more luminous than the flame at that earlier period.

Any of the stages described may, from a variety of causes, be prolonged; or an insufficiency of blast, however caused, may lengthen the entire period of the blow for several minutes, but the above is a fair average blow with the best English hematite pig-iron. If inferior irons are used, the flame at the change is more or less enveloped in a dense white smoke, and the change is accompanied by violent pulsations, or "coughings," of the entire flame, which, under these circumstances, has often a yellowish red colour to the eye; all this making the change often very difficult, if not impossible, to detect. Nervousness or biliousness, by variously affecting the sight of the observer, may also render him unable with certainty to determine the precise moment when he ought to "turn down"; and there is a marked difference in the facility of observation no-

ticeable between a blow taking place in daylight and one at night.

2nd. The Appearance of the Flame as Examined by means of the Spectroscope.

It was important, first, to note if any of the lines belonging to the Bessemer flame were to be found in the flame given off from the coke fire used to heat up the converter. Several examinations were made; the result of these was that, besides the invariable yellow bright line, the red line, and the two bright green lines next the yellow, were occasionally to be seen. Owing, however, to the want of brilliancy of this flame, the spectrum which it gave was very faint, and, at times, almost invisible.

On first turning up the vessel, and for about four minutes thereafter, the spectroscope showed only a continuous band of light, with the colours rather hazy, and so much blended with one another as to make it impossible to mark the junctions of the different fields.

In from four to six minutes, flashes of the yellow line became visible (corresponding to the appearance of tongues of a bright flame, shooting up in the centre of the dull red one issuing from the mouth of the converter); and in one or two minutes after its first appearance, this line became quite steady, and did not disappear even at the end of the blow. Simultaneous with the steadying of the yellow line, the red, yellow, and green fields became clear and well-defined bands of bright colour.

In half a minute to a minute later, a bright green line appeared near the yellow, following which, in scarcely ever more than half a minute, a red line appeared, equi-distant from the yellow (of course on the opposite side). These two generally became steady together (having first appeared in intermittent flashes) in about half a minute after both were visible. With the steadying of these two lines at once, a second green line (bright, and about the centre of the green field) became visible, wavering a little at first. About a quarter of a minute served generally to steady it, although sometimes it was a minute and a half from the appearance of the first green line till the second green line with the red became steady.

In one or two minutes, a third green line, nearer the blue field, came into view, and in about one minute was steady. When the red appeared with the first green line, the second and third green lines generally appeared together; but when the red appeared with the second green line, the third green was accompanied by a blue bright line near the green field. In about ten minutes after turning up the converter, the flame attained its maximum size and intensity of light, when a second and third bright line became visible in the blue field. Very often these were only intermittent and very faint; but with "hot metal," and a bright flame, they were pretty steady and distinct, and were broader than those in the yellow, green, and red fields.

Occasionally, for about two or three minutes before the close of the blow, a bright line was seen in the purple field, pretty far to the right of the spectrum; sometimes this only flashed brightly, but on a few occasions it was clearly seen, though faint.

With a very bright flame, several dark lines were seen, but, for want of definiteness, it was impossible to say, whether they were not due to the contrast afforded by the brilliancy of the bright ones beside which they appeared. A narrow dark line was seen on each side of the red line, and a broad dark band dividing the

yellow from the green; then one between each green line, and two in the blue field, between the three blue lines. But these were only seen with an exceptionally bright flame, and, therefore, are not of much importance.

All the bright lines visible remained steady for several minutes before the close of the blow, affording an excellent opportunity for their examination; but, at the last, all (with the exception of the yellow) faded in less than thirty seconds. The purple line disappeared first (whenever it happened to be visible), then the three blue lines, in the inverted order of their appearance, then the third green, after which the second, then the red, and last of all the first green, when the blast was shut off.

The green and the red lines, from their distinctness, afforded the best point for a determination of the process; and these were so constant, that a sure indication could always be given by any of them, if it were made the index by which to determine the period of blowing.

Very often, on adding the charge of spiegeleisen, a large and very brilliant flame rushed out of the converter for some minutes, and on examining it, the red, yellow, three green, and a very brilliant purple line were seen, but no blue.

3rd. Some Experiments with Coloured Glasses on the Flame.

I shall now proceed to describe some experiments made with coloured glasses on the Bessemer flame. I may mention that what led to them was my brother being compelled to get very dark spectacles to protect his eyes, which were not very strong, from the intensity of the light of the flame. The first pair made completely overcame the brilliancy of the flame, without imparting any colour to it; but, on ordering a second pair, they showed so much colour as to render them useless. On appealing to the workman who had made them, he found that no note had been kept of the kinds of glasses which had been used in the first pair; and, although several attempts were made to repeat them, the second pair sent was the best he could accomplish, and they had appeared colourless to sunlight. The thought then occurred, that, as the brilliancy of the flame varies considerably during its existence, a variation in the amount of transmitted light might be found to affect, in proportionate degree, the power of some coloured glasses to absorb other colours in combination with them, and that a combination of colours might be found to give, with a small quantity of transmitted light, a distinct colour, which could be quite absorbed when a larger quantity of light was passed through the same glasses.

Another, and perhaps the most important, consideration which led to the following experiments, was that the flame itself has a varying chemical composition as the silicon, manganese, carbon, and iron become successively attacked, and that the temperature of the flame at these various stages must necessarily be altered, giving rise, of course, to various colours, or shades of colour, in the flame. If, therefore, a combination of coloured glasses could be found which would absorb the colour due to the flame at a particular temperature, it seemed clear that a change of temperature would become immediately visible, on account of an accession or diminution of colour to the flame as thus observed. It is probable, too, that the colour possessed by the flame at its different stages is due to the various elements

which are at these periods being volatilised, but the spectroscope does not throw much light on this supposition.

The first combination of coloured glasses which I have noted are a

Ruby and Emerald.	{ It was found that these colours mutually destroyed each other. The Bessemer flame, when viewed through them, appeared white and without brilliancy.
Ultramarine blue, Dark yellow.	
	{ This combination gave the same effect as above.

With a combination consisting of—

Ultramarine blue, Dark yellow, Ultramarine blue, Emerald.	{ The flame appeared of an emerald colour, but was dark and without brilliancy.

In the next experiments, the dark yellow and one blue were replaced by a light yellow and neutral tint, thus:—

Ultramarine blue, Light yellow, Neutral tint, Emerald.	{ The appearance of the flame in this case was similar in colour to that afforded by the above combination, but appeared of considerable brightness.

In the next experiments, the light yellow and neutral tint were replaced by a dark yellow and red, respectively, thus:—

Ultramarine blue, Dark yellow, Ruby, Emerald.	{ The flame at first was dimly seen, and without colour; when it reached its maximum brilliancy, it still appeared white through this combination.

With these five combinations, the appearance of the sun, as seen through each of them, was similar in character to that of the flame, but more powerful in degree.

In the subsequent experiments, the combination was as follows:—

Ultramarine blue, Dark yellow, Neutral tint, Ultramarine blue.	{ The flame appeared at first of a ruby red colour, increasing in size and intensity as the blow progressed, the edges of the flame acquiring a lighter shade of red, but the colour was too strong to admit of the changes being easily determined. Sunlight, through this combination, was slightly yellow.

In the succeeding experiments, one of the blue glasses was replaced by a light yellow, giving a combination of—

Ultramarine blue, Dark yellow, Neutral tint, Light yellow.	{ The flame appeared at first of a yellowish red colour; as the blow progressed this colour became whiter, with flashes of redder flame occasionally through it. At the flame's maximum brilliancy, the edges assumed a light red colour (nearly white), while at the root and centre of the flame the colour was of a darker yellowish red. When the flame dropped (at the end of the blow), it returned to a yellowish red colour, somewhat similar in appearance to the effect produced at the beginning of the blow. Sunlight appeared slightly yellow.

It will be observed that this combination gave nearly the desired effect—viz., a variation of depth of colour due to the differences of temperature or brilliancy of the flame at its different stages of progression. The yellowish tint, however, always present, showed a defect in this combination, to overcome which further trials

were made. Among other devices, the light yellow was omitted, and the flame was observed with—

Ultramarine blue,	{	The flame appeared still red, and with the yellowish tint, though in such small degree as to show that the desired result was not far off. Sunlight appeared dim, and slightly yellow.
Dark yellow,		
Neutral tint.		

In the concluding experiments, the neutral tint was replaced by a blue glass, with the object of ascertaining whether the yellow colour could be corrected by the omission of the red or the blue component of the neutral tint, thus:—

Ultramarine blue,	{	This combination was perfectly successful, the lingering trace of yellow being removed.
Dark yellow,		
Ultramarine blue.		

I shall now describe more fully the appearance of the flame through it.

For the first four or five minutes all is dark; the chimney is invisible; nothing but the mouth of the converter can be made out, which appears slightly red, the sparks coming from it being scarcely visible. As the blow progresses, the flame, still red in colour, increases in size and luminosity, while the outline of the vessel becomes visible. In about twelve to fifteen minutes the flame begins to lose its colour, becoming violently agitated, flashes of a lighter and brighter flame shooting up occasionally.

In about fifteen minutes a purple tint becomes visible round the mouth of the vessel, the flame gradually acquiring a white colour towards the edges.

When the flame has reached its maximum brilliancy it appears bright and nearly white, with the edges purple. The red colour thereafter begins to re-appear at the mouth of the vessel and centre of white flame, gradually extending until the whole flame appears of a light red colour.

And with the peculiar hollow sound heard in the vessel always preceding the drop, the centre of the flame begins to acquire a deeper colour; this quickly extends and deepens. Within a minute or so of the drop the whole flame becomes crimson, and losing its brilliancy, and within half a minute, it suddenly goes back to very nearly the red colour it had at starting.

This combination of glasses is now in daily use in the Atlas Works, its indications being so marked and unmistakable as to render its use safe in the most inexperienced hands. This little instrument or "Chromopurometer," as it is proposed to call it, is arranged as follows:—

One of the blue glasses and the dark yellow one are fixed in a rectangular frame, carrying at its foot a hinge to which the thin frame holding the other blue glass is attached, and at its top a spring catch to hold this smaller frame when in its shut position, and also a pin and set screw for attaching the whole instrument to the hat of the observer so as to place it before his eyes.

The object of having the glasses thus divided is to give facility for the observation of the flame through the combination of three, while during the pouring two being sufficient, the third one is allowed to hang down, when it serves to protect the lips from the great heat of the ladle and liquid steel.

In conclusion, I think it is probable that, by carefully noting by means of coloured glasses such as that described, the amount of light (as determined by the shade of colour visible) emitted by flames of known temperature, a scale might be formed which would enable us approximately to measure the temperature not only of

the flame of the Bessemer Converter, but also that of many flames which have hitherto been considered beyond reach of our ordinary methods of measurement.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

BY DR. E. FLEISCHER, OF DRESDEN.

THE SYPHON FILTER.

The operation of filtering gelatinous precipitates is well known to be one which consumes much time, especially when, as is frequently the case, it is desirable that the deposit should be thoroughly washed. Neither will decantation materially hasten the operation, because most gelatinous precipitates (especially alumina) settle only very slowly, and not always clearly, so that the supernatant liquid must still be filtered in most cases. Granular deposits also retard filtration to a considerable extent, as soon as the filter employed becomes only partially filled with them.

Lastly, the washing upon the filter of a not inconsiderable number of precipitates is always a very uncertain affair, because the washing water by no means always penetrates the entire mass, but much oftener finds out for itself certain channels which afford it an easier passage through the filter. All these drawbacks may, however, be remedied by using, instead of the ordinary filter, an instrument which filters and decants at the same time. A similar kind of filter, which I shall call the syphon filter, because it is founded on the principle of the syphon, has often been proposed for use in rapid filtration; nevertheless, among all these contrivances, we do not possess one of a suitable form for analytical purposes, although many may be used for manufacturing operations, especially on a proportionately large scale. I, on the contrary, have taken some trouble to render this principle of the syphon pressure applicable to quantitative estimation, and subjoin a description of my syphon filter as now manufactured according to my own plan by the well-known firm of Franz Hugershoff in Leipzig.

A is a double bent funnel; each bend is 1 decimetre long: the height of the receiver-shaped funnel is little more than 2 centimetres, the width 3 centimetres. This syphon is joined at its free end to an india-rubber tube united to a straight glass tube, so that the length of the entire shank of the syphon is made to approach 50 centimetres. The glass tube which is joined to the india-rubber pipe passes through a doubly perforated india-rubber stopper which fits into the pipe, c, which tapers to a point. The second hole in the stopper contains the suction pipe, z, which only just passes through and is bent at right angles.

In order to filter, there must first be spread over the mouth of the funnel a suitable round piece of muslin and upon that a similar piece of filtering paper; the muslin must be alike unaffected by acids or alkalis. Both filtering media must then be held by means of a tight india-rubber ring in the bell-shaped funnel; the filtering medium is sprinkled with distilled water and placed in the beaker, which serves to receive the substance to be filtered. It will be necessary in order that as little fluid as possible may be left behind in such filtrations, and that no unnecessary quantity of water be used in washing, that certain dimensions which have proved to be the best should be adhered to in this ves-

* Communicated by the Author.

sel; success will then be certain. It will conveniently contain 100 c.c., and the quantities of liquid which are left from such filtrations and which contain the deposit amount to scarcely more than 5 c.c. Even when *b* contains no deposit there does not remain more than 7 c.c. at most after filtering the clear liquid; but since the vessel is filled each time with at least 100 c.c. of the liquid, the residue will amount to 1-20th of the fluid used, so that a deposit, after threefold washing contains only 1-150,000th of the substance which was disseminated and contained in the original mass. It will be seen by this that in most analyses one washing instead of three will give a sufficiently pure residue; the washing water may also be more completely utilised than by employing the ordinary funnel filter, because it can be better agitated with the deposit. Lastly, the filtering surface always remains pure, because the filtration takes place from beneath to above, and in consequence of this and of the considerable pressure of 50 c.c. of liquid, the filtration takes place in about one-fifth of the time required when using the ordinary filter instead; since there is an average discharge of 20 c.c. of liquid per minute. The process of filtering is as follows:—*b* must be placed upon the table at such a height as to be convenient for stirring and filling; the vessel, *x*, which receives the filtrate stands lower. As soon as *b* is filled the suction pipe, *e*, must be exhausted, and at the same time the opening, *o*, must be closed with the forefinger; when the liquid has arrived in the india-rubber pipe, *r* is placed under it and the filtration continues as long as the filtering medium is covered with liquid. When this is no longer the case, *b* is again filled with the liquid or substance to be filtered, and the whole well agitated by repeatedly raising and lowering the funnel.



One filtration being finished, the funnel is washed, together with the paper over *b*, which in order to preserve the last drops of the liquid, is held up and pricked. If it be desired to ignite and weigh the residue, it must be washed out of *b* into a small platinum dish, which is then placed over a water bath to evaporate all moisture, and heated either in the dish itself or in a porcelain or platinum crucible. The desiccation in the drying room may be omitted and also the burning of the filter, as they would take up too much time. Should it be necessary

for a deposit to be again dissolved, one great convenience of this contrivance is, that at the end of the filtration it will be found ready in the beaker with a minimum quantity of water, thereby removing the inconvenient rinsing out of the filter, a part of the process which in the case of strongly adhering deposits requires large quantities of water.

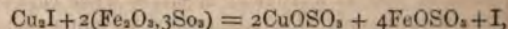
These are the essential advantages of the syphon filter. I always employ it if the fluid to be filtered amounts to more than 100 c.c., or if a voluminous deposit is to be washed.

ON THE SEPARATION AND ESTIMATION OF COPPER IN THE PRESENCE OF OTHER METALLIC SALTS.

In order to ascertain the amount of copper in a liquid which also contains other metallic salts, it will be found

advisable to separate the copper from the solution in such a form as will be best adapted to its further estimation.

In analytical estimations of copper by weight, use may frequently be made, in the presence of sulphides easily soluble in weak muriatic acid, of the property possessed by chloride of copper of being precipitated in a warm acid solution by hyposulphite of soda. A drawback of this method is, however, that it does not allow any direct weighing of the dried precipitate, on account of the sulphur which is separated at the same time with the copper sulphide. Some chemists have recommended iodide of potassium, others, especially Rivot, sulphocyanide of potassium, for the separation of copper in acid solutions; neither of these are, however, to be especially recommended for analytical estimation by weight, because they do not allow of precision being attained by direct weighing. On the contrary, both these haloid salts of copper are highly suitable for its separation from other metallic salts and for the analytical determination of copper by measure, because almost all iodides and sulphocyanides collectively are easily soluble in muriatic acid, while, on the other hand, iodide or sulphocyanide of copper is insoluble, so that it is not possible to discover in the filtrate, after precipitation, any trace of copper by the aid of ferrocyanide of potassium. Of course much depends, especially for the complete precipitation of the iodide of copper, upon the means of reduction employed. Salts of sulphurous acid and even protochloride of iron are inappropriate, because iodide of copper is soluble in an excess of sulphurous acid, and still more easily so in sesquichloride of iron; but if a reducing agent be employed in precipitating the iodide of copper, capable, before the addition of iodide of potassium, of reducing cupric salts to subsalts, the precipitation of the iodide will be thoroughly complete. The most convenient reducing agent of this kind, and that best adapted for the purpose, is chloride of tin. If a solution of chloride of copper or blue vitriol be mixed with an excess of chloride of tin, the copper will be transformed into subchloride or subsulphate. On the addition of iodide of potassium, the copper will be so completely precipitated that no trace will be discoverable in the filtrate. As this iodide of copper is, then, one of the most suitable forms in which to analytically estimate copper by measure, I will proceed to describe the method more closely. With the aid of sulphate of peroxide of iron, which it transforms into a salt of protoxide, according to the formula—



after separating the simultaneously-deposited iodine, the amount of copper may be easily calculated from that of the protoxide of iron formed, which is found by permanganate of potash. In order to obtain the copper as a chloride in a state of solution, it is necessary either to dissolve the oxide in muriatic acid, or to transform the sulphate into chloride by the addition of chloride of potassium or chloride of sodium. The presence of sulphate of potash will be found in no way detrimental. Nitrates may be treated in the same way, or, if too much free acid be present, it may be decomposed by digesting with excess of protochloride of iron. After the chloride of iron has been formed by one of these two methods, there must be added a proportionately large quantity of sal-ammoniac, say about 100 c.c. fluid, 8—10 grammes solid, salt. With this must be mixed distilled chloride of tin, or the yet

stronger solution of chloride of tin and sal-ammoniac, in such a proportion as to transform the whole of the copper into subchloride; if iron be also held in solution it will naturally be reduced to protoxide. It is obvious that a solution can contain no subchloride of copper in the presence of sesquichloride of iron, but that in the presence of chloride of copper it may contain protochloride of iron. If the reduction is sufficient, a paper dipped in strong iodide of potassium will not turn blue. Should it now be wished to precipitate the copper as iodide, an iodide of potassium solution must be added in sufficient quantity, and the cold fluid allowed to settle well.* In the presence of much sal-ammoniac this takes place very quickly, while, at the same time, the tendency of the finely divided iodide to go through the pores of the filter is prevented. The iodide of copper, which is filtered off, must now be washed with a solution of sal-ammoniac until a solution of nitrate of silver in caustic ammonia will no longer render turbid the liquid which runs through, and until the latter will not precipitate Prussian blue from a mixture of diluted sesquichloride of iron with two drops of prussiate of potash. The iodide of copper which was washed is now placed in a solution of nitric acid, chlorine, and free sulphate of peroxide of iron, which more than suffices to transform all the copper into sub-salt; the free iodine is then driven off by heat until iodide of potassium and starch paper is not turned blue by the fumes, and diluted with cold water. The amount of the original protoxide of iron is now estimated with manganate of potash, and then the amount of copper is calculated according to the above-mentioned formula. It will be perceived that it is possible to estimate the liberated iodine by employing closed vessels, from which it is distilled into a solution of iodide of potassium, nevertheless I consider this process as superfluous, since the estimation of iron belongs properly to the most exact analytical methods.

Inasmuch as iodide of copper is an appropriate compound for the estimation of copper, so it is also especially adapted to discover and separate combined iodine in the presence of chlorine and bromine; and it fully replaces the expensive employment of palladium, provided the stated precautions are adhered to, and so much the more as it permits a direct estimation of iodine. An equally convenient method of estimating and separating copper is presented by precipitation by sulphocyanide of potassium. In the absence of sesquioxide of iron, copper can be as easily separated from its solution by sulphocyanide of potassium, when sulphite of soda is used as a reducing agent, as when chloride of tin is employed. The addition of sal-ammoniac is not indispensable, but it effects a better filtration and prevents the separation of oxide of tin.

The sulphocyanide of copper which is deposited from the muriatic acid solution is washed until the washings are not rendered turbid by alkali; the deposit is then digested for some minutes with a solution of caustic soda or potash; the red suboxide of copper now formed is allowed to settle a little and quickly filtered off. It is then washed with hot water until it no longer communicates a red tinge to acidulated sesquichloride of iron; the suboxide is then dissolved in a solution of sulphate of peroxide of iron, and estimated according to the known process. The estimation of copper as a sulphocyanide will be perceived to be rather more detailed than that of the iodide; however, by this method

* Here the syphon filter will be found very convenient if the precipitate be not too insignificant.

one may avoid the removal of the iodine by large quantities of water, which always takes up time. Moreover, as I have myself proved, sulphocyanide of copper serves as a means of estimation for hydrosulphocyanic acid even in the presence of cyanogen. I have observed in such cases that the transformation of the cyanogen into ferrocyanide of potassium (which is effected by digesting the alkaline solution with oxidised green vitriol) and the subsequent separation of the ferrocyanide of potassium from the acidulated solution, produce a very useful separation of the cyanogen from the sulphocyanogen, especially if a little chloride of tin be previously added, so that all the iron may be held in the state of protoxide. It has already been remarked that copper can be separated in the presence of salts of other metals by either iodide or sulphocyanide of potassium. Lead, silver, and mercury alone are troublesome; however, silver may be separated by muriatic acid, and lead is precipitated with sufficient completeness by the addition of sulphuric acid. By means of chloride of tin, mercury is also deposited as Hg_2Cl , provided the solution be cold, so that the separation of copper from these three metals is tolerably simple. In the case of native sulphides I prefer, instead of the tedious and troublesome decomposition by *aqua regia*, fusing them with four parts of dry soda, three parts chlorate of potash, and two of common salt; this will effect, in a few minutes, a quiet and decided oxidation of the pyrites. The fused mass is directly dissolved in muriatic acid, and the copper separated from the filtered solution in the form of iodide or sulphocyanide, according to the method above described.

ANOTHER NEW ELEMENT ASSOCIATED WITH ZIRCONIUM.

From a letter received from Mr. H. C. Sorby, dated April 13th, we learn that he has discovered spectrum evidence to prove that, independent of jargonite, zircons from different localities contain two distinct earths, occurring in very variable proportion, so that some appear to contain little or none of one, and others to be chiefly composed of it.

ON THE PITCHSTONES OF THE ISLAND OF ARRAN.

BY J. WALLACE YOUNG.

THE pitchstone dykes and veins in Arran are of great interest to the geologist, the mineral being comparatively rare in Britain.

Pitchstone appears of a dark blackish green colour, almost like a piece of bottle glass, sometimes with small specks, and, occasionally, large crystals of felspar disseminated in the base, giving it a more or less porphyritic texture.

When small chips, or properly prepared sections are examined microscopically, it is seen to consist of a colourless glassy base—probably hydrated felspar, and having, according to Mr. Sorby, no action on polarised light. Scattered throughout are great numbers of dark green prismatic crystals, crossing in all directions, and often in stellate groups. On applying heat to a thin splinter, water is expelled, and it becomes opaque, the opacity being due to the minute vesicles produced by the expulsion of the water.

B.B. pitchstone becomes white, and fuses with diffi-

culty to a very vesicular glass. Fracture, conchoidal, splintery.

The finely elutriated mineral is acted on to a slight extent by digestion with HCl; with HS_2O_4 the action is a little greater.

Pitchstone, when weathering and decomposing, becomes opaque and greyish white, and is not difficult to pulverise. In this state it is acted on very considerably with HCl; the SiO_2 separating partly in a gelatinous form. A specimen of weathered pitchstone from the Corruggills shore, dried at 100°C ., lost 11.69 per cent of water on ignition.

The following table shows the compositions of four different specimens:

	I.	II.	III.	IV.
Silicic acid.....	72.55	73.00	71.94	71.27
Alumina.....	12.08	12.27	12.31	11.60
Ferrous oxide.....	1.50	1.27	1.31	1.69
Lime.....	0.50	0.50	0.80	0.95
Potash.....	4.32	3.92	4.27	4.17
Soda (by difference)....	3.64	3.92	4.00	3.45
Water.....	5.41	5.12	5.37	6.87
	100.00	100.00	100.00	100.00

No. 1. From the large vein on the Corruggills shore. This forms a broad, almost horizontal band in front of the sandstone cliffs. A few small felspar crystals scattered throughout the smooth, blackish green mineral. Sp. gr. 2.336.

No. 2. From the great vein, about 30 feet broad, which crosses the old Lamlash Road at right angles. More porphyritic in character than any of the others. Sp. gr. 2.327.

Nos. 3 and 4. From Moneadh-Mhor Glen. The two pitchstone dykes are well exposed in the bed and banks of the stream. No. 3. Blackish green; smooth. Sp. gr. 2.343. No. 4. Greyish green; texture somewhat coarse. Appears as if in a state of incipient decomposition. Sp. gr. 2.323.

From the microscopical examination of a great many different varieties, it would appear that the more porphyritic kinds show the greatest number of green prismatic crystals. In the specimens Nos. 1 and 3, they are not so numerous; but higher microscopic powers show immense quantities of very small, needle-shaped crystals disseminated throughout, and frequently surrounding the larger crystals like a fringe, appearing to have separated out and grouped themselves in this manner, the base in the neighbourhood being comparatively free from them. The larger crystals have apparently been first formed, and in some cases, have acted as a sort of nucleus for the smaller ones.

ON SOME NEW ANILINE DYES.

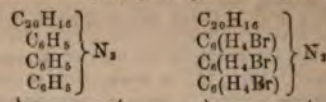
BY W. H. PERKIN, F.R.S., SEC. C.S.

At a recent meeting of the Chemical Section of the Philosophical Society of Glasgow, Mr. Perkin made some observations upon artificial colouring matters, which he illustrated experimentally.

The first remarks were upon the action of chloride of lime on aniline, the formation of Runge's blue, and its conversion into mauveine, being shown. The particulars of these results have already appeared in the *CHEMICAL NEWS*.

An instance of how little the replacement of hydrogen by bromine in a colouring matter will at times influence its colour and properties, was shown and remarked upon by the formation of a blue the author had

produced from a salt of rosaniline and bromaniline. This blue possesses both the colour and most of the properties of ordinary triphenyl-roosaniline, although it must contain bromophenyl in place of phenyl, thus:—



Tri-phenyl-roosaniline. Tri-bromophenyl-roosaniline.

This substance appears to differ from the ordinary blue only in being less soluble in alcohol.

An experiment was then made in reference to the peculiar property mauveine possesses of becoming colourless, like indigo, with reducing agents, and then assuming its ordinary colour again when exposed to the oxidising influence of the air, a property showing this colouring matter to belong to a different class of compounds to rosaniline.

The next subject was in relation to a colouring matter which had been obtained several years since by Mr. Perkin, but only in small quantities, in the preparation of aniline purple with bichromate of potassium and a salt of aniline. This substance produces, upon silk or cotton, shades similar to those obtained with safflower, and owing to a somewhat improved process for its production endeavours are now being made to introduce it into the arts, especially as it possesses advantages over safflower. It is, however, still difficult to manufacture; it is called aniline pink, and sometimes safranine.

This substance is at present under examination; it does not appear to be at all related to rosaniline, but to possess properties similar to those of mauveine, as it gives the same reactions with acids, and with reducing agents becomes colourless, but, when exposed to the air, rapidly assumes its original tint, exactly in the same manner as the mauve.

Like most of the coal tar colours, it is an organic base. It forms very soluble salts, most of which are crystalline, and possess a green metallic lustre.

One of the most remarkable of its properties is the peculiar orange-coloured fluorescence of the alcoholic solution of its salts. This was illustrated by means of the magnesium lamp.

Mr. Perkin has not yet decided upon the formula of this colouring matter, but is at present engaged with the subject. It appears to contain much less carbon than mauveine.

PRELIMINARY NOTICE

ON THE MINERAL CONSTITUENTS

OF THE

BREITENBACH METEORITE.*

BY PROFESSOR N. STORY MASKELYNE, M.A.

THIS meteorite, which belongs to the rare class intermediate between meteoric irons or siderites, and meteoric stones or aërolites, was found in Breitenbach in Bohemia.

It is a spongy metallic mass, very similar to the siderolite of Rittersgrün in Saxony, the hollows in the iron being filled by a mixture of crystalline minerals. These minerals seem to consist almost entirely of two; and the present notice deals with these two minerals.

* Abstract of a paper read before the Royal Society, April 8th, 1869.

1. One of them is of a pale green colour, crystallising in the prismatic system, and presenting at once the formula of an augitic mineral and a crystalline form nearly approaching that of olivine.

The analysis of this green mineral gave, from 0.4127 grm.,—

		per cent.
Silica.....	0.2315	56.101
Magnesia.....	0.1247	30.215
Ferrous oxide....	0.0560	13.583
	0.4122	99.899

results which correspond very nearly with an Enstatite of the formula $(Mg\frac{1}{2}Fe\frac{1}{2})SiO_3$. The specific gravity is 3.23.

2. The other mineral is one of very great interest. It is, in short, silica crystallised as tridymite. In bulk it forms about a third part of the mixed crystalline mass.

The crystals are very imperfect; but measurements accord with those of an hexagonal crystal.

A section made for examination in the microscope showed two small crystals in which the axis happened to be normal to the section. Light traverses these crystals with equal brilliancy during the rotation of the crystal between crossed Nicol prisms. That this was due to gyratory polarisation, and of a right-handed kind, was shown in the following manner:—

A comparative experiment was made with two sections of quartz of opposite qualities, and of the requisite thickness, to give the "sensitive tint" with crossed Nicols; and below these were placed two thin sections of right-and-left gyrating quartz, giving an orange tint. The two minute microscopic sections gave, on comparison of the colours in the centre of the field, in each case, unmistakable evidence that the gyration was similar to that of "right-handed" quartz.

There can be no doubt from these results that this mineral is silica in the form of its opaloid crystal, to which Von Rath has given the name of tridymite.

The analysis of the mineral gave, by distillation of the silica as silicic fluoride, and subsequent determination as potassic fluosilicate, 97.43 per cent of silica; the remainder being oxide of iron and lime. Thus 0.3114 grm. gave—

		per cent.
Silica.....	0.3034	97.430
Ferric oxide.....	0.0035	1.124
Lime.....	0.0018	0.578
	0.3087	99.132

A second analysis gave 99.21 per cent silica, 0.79 of residue.

Its specific gravity, as determined from a very small amount of the mineral picked under the microscope, was 2.18; a second determination made on a larger amount gave the value 2.245. That of tridymite is 2.295 to 2.3. This may be taken as evidence that the mineral is not quartz, the specific gravity of which is 2.65. Von Rath's experiments were made on a rather less pure form of tridymite.

ON THE DISTILLATION OF DENSE HYDROCARBONS AT HIGH TEMPERATURES,

TECHNICALLY TERMED "CRACKING."

BY S. F. PECKHAM.

In the American reprint of the *CHEMICAL NEWS* for June of this year (*Am. Repr.*, June, 1868, page 257)

VOL. IV. No. 6.—JUNE, 1869.

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[English Edition, Vol. XIX., No. 489, pages 182, 183.]

an article appears "On Naphtha and Illuminating Oil from Heavy California Tar," by Prof. B. Silliman, copied from the *San Francisco Bulletin*. In the September number of the same Journal, an article appears "On the Distillation of Hydrocarbons," by Joseph Hirsch, Ph.D., in which the results obtained by Prof. S. are subjected to criticism, and certain statements made in reference to the subject of a most extraordinary character.

At the same time that Mr. Corning was engaged upon the experiments, the results of which form the subject of Prof. Silliman's paper, I was engaged upon experiments of a similar character for the Geological Survey of California, the results of which have not yet been published.* These results differed somewhat from those obtained by Prof. S., as also the method by which they were obtained. I shall, therefore, give a brief summary, both of method and results, and compare the conclusions to be derived from them with the statements made by Dr. Hirsch.

Those who first attempted the manufacture of commercial oils from crude California materials, when operating with the upright still in common use for the manufacture of Pennsylvania oils, encountered an apparently insurmountable obstacle, viz., a large proportion of the distillate was neither light nor heavy, neither burning oil nor lubricating oil, but an oil intermediate in density between the two, and therefore not merchantable. The difficulty was so far overcome by enclosing the stills in brickwork, heating them entirely by radiant heat, and distilling very slowly, that the amount of heavy lubricating oil was largely increased, and the "middlings" correspondingly diminished. The yield of illuminating oil, however, was very slightly increased, and it was for the purpose of securing a larger yield of that material, that my experiments were undertaken. I had at first intended to subject them to Mr. Downer's process of slow distillation in a high, upright still, the top of which was exposed to radiation. The small quantity of crude material at my command (5 gallons of each variety) rendered this operation exceedingly difficult to conduct successfully, and it was with extreme satisfaction that I saw at the time, in the October number of the *CHEMICAL NEWS* for 1866 (*Eng. Ed.*), an announcement that Mr. Young of Glasgow had obtained a patent for the manufacture of illuminating oils from heavy paraffine oils, by distillation under pressure. It was necessary that I should operate on a small quantity at a time, and also, that I should subject the four or five different samples which I had to the same treatment, in order that I might compare the results, and judge of their relative value. For that purpose I contrived the apparatus described in the September number of this Journal for 1867, which, so far as I know, has but one fault, viz., the chamber of the valve is too small, and should be enlarged sufficiently to enable the pressure to be regulated by weights instead of by a spring.

With a pressure of between 30 and 40 pounds per square inch (the exact amount was not ascertained) the following results were obtained:—

Percentage Results of Distillation under Pressure.

	I.	II.	III.	IV.
Volatile impurity, consisting of air and water. —	—	—	—	12.5
1st pressure distillation of crude material.	91.1	87.66	82.86	79.2
Coke and loss at do.	9.1	12.34	17.34	15.5

* The volume of Reports of the Survey on "Economic Geology," containing these results, is now ready for the press, but its publication is delayed by the failure of the last California Legislature in making the necessary appropriation.

	I.	II.	III.	IV.
1st fractionation of sp. gr. 43° B.=0.810.....	42°—	56°72	40°33	16°7
Leaving heavy residue for re-distillation.....	49°—	30°94	42°33	55°3
Which yielded, by 2nd pressure distillation.....	44°15	27°84	58°09	49°8
2nd fractionation of sp. gr. 43° B.=0.810.....	12°25	6°96	9°52	12°4
Total crude illuminating oil.....	54°25	62°68	49°65	29°1
Loss in treatment of do. 3-100ths.....	1°62	1°88	1°49	0°9
Total yield of refined oil.....	51°25	60°70	48°16	28°2
Total crude lubricating oil.....	31°85	20°88	28°57	37°4
Loss in treatment of do. 3-100ths.....	0°95	0°62	0°85	1°1
Total refined lubricating oil.....	30°90	20°26	27°72	36°3
Yield of refined illuminating oil, sp. gr. 43° B. 51°25	60°70	48°16	28°2	
Yield of refined lubricating oil, sp. gr. 23°—				
25° B.....	30°90	20°26	27°72	36°3
Loss in treatment.....	2°61	2°50	2°34	2°05
Coke and loss in distillation.....	18°24	16°54	21°58	33°5
Yield of illuminating oil by ordinary process.....	15°00	20°00	3°00	2°0

No. 1 was an oil procured from one of the tunnels of the Hayward Petroleum Company, of a specific gravity of 0.9023, yielding by distillation in a common still about 15 per cent of light oil, of a specific gravity of 0.810, with about 40 to 50 per cent of "middlings" and 20 per cent of light lubricating oil.

No. 2 came from the celebrated Pico Spring, yielding the lightest oil of any natural outcrop in Southern California. Its specific gravity was 0.8932, and it yielded to treatment by the ordinary method only about 20 per cent of illuminating oil of the proper density.

No. 3 was from the Canada Laga, of specific gravity of 0.9184, and yielding by the ordinary process only 3 per cent of illuminating oil.

No. 4 was a sample of Maltha from the same spring as that operated upon by Prof. Silliman. Its specific gravity was 0.978, and it yielded about 2.5 per cent of illuminating oil.

This table exhibits the results of actual experiment, not of theory; and while they differ from those obtained by Prof. Silliman, the difference is in degree and not in kind, and is without doubt due to the superiority of the apparatus used by myself, and to a higher degree of pressure employed. Both series of experiments confirm each other, and alike prove that dense petroleum and a thick heavy tar—as thick as ordinary molasses—which yield practically little or no illuminating oil by ordinary treatment, by distillation under pressure are subjected to what is technically termed "cracking" and made to yield from 28 to 60 per cent of oil fit for burning, and rendered thereby nearly as valuable as the crude oils of Pennsylvania.

Dr. Hirsch criticises these experiments as not being executed under circumstances "parallel to the distillation on a large scale." He then states, that, during the distillation of hydrocarbons on the large scale, "the process of 'cracking' always takes place in some degree," as "all hydrocarbons of high boiling points contained in such mixtures are, during distillation, exposed to varying degrees of temperature below their own boiling point, as long as those hydrocarbons of lesser gravity and lower boiling point have not been removed by distillation." He further states, that "it is this exposure to a lower degree of heat than corresponds to the distilling point of an oil of definite gravity, which comprises the operation of 'cracking.'" Again, he states, that during slow distillation in the enormous stills now being introduced, "cracking" takes place without any "special efforts" to produce such a result, "while only a small portion distils over as paraffine oil, that being due to overheating." He next states, that by rapid distillation of a small quantity, the different hydrocarbons which make up the petroleum come over

unchanged, and that the difference between this last-named distillation and the former, is the same as the one between distilling coal for the production of illuminating gas, and that for producing coal oil; the former producing a dense tar, being carried on in small low retorts, and the latter in revolving retorts of large capacity. "In these the oily vapours are exposed to a cooler temperature than their own with every revolution of the retort, and are in this manner broken up into oils of lighter gravity."

He then gives a number of rules, the result of his own experience.

"1st. * * * the more the temperature of the actual boiling point of oil of definite gravity is above the temperature to which the same oil is raised, the greater is the quantity of light oil obtained.

"2nd. The gravity of distillate resulting from reduction of temperature will be directly proportionate to said reduction. * * * In distillation, the temperature, therefore, should always be reduced to the boiling point of the oil of the specific gravity desired.

"3rd. The difference between the temperatures of the two boiling points, viz. of the oil being subjected to distillation and of the derived distillate, is in direct proportion to the height of the still employed, or to the facility for cooling the upper portions of the still.

"4th. The intensity of the process of 'cracking' is proportionate to the suddenness with which the oil vapours are condensed before leaving the still.

"5th. The difference in gravity between that of the oil distilled and the desired distillate is in direct proportion to the quantity of water produced in the process.

"These laws are the same with hydrocarbons distilled under the ordinary atmospheric pressure, as with those distilled in a vacuum, or under increased pressure."

It is very rarely that as many errors are included within as little space, and the entire discussion exhibits in a remarkable degree to what totally erroneous conclusions the results of close observation and experience may lead when explained upon a false hypothesis.

The operation of "cracking," as conducted by Mr. Downer, consists in a slow distillation of oils of high specific gravity, and high boiling point, in a still furnished with a high dome, the outer surface of which is freely exposed to radiation. As distillation proceeds, those oils which are condensed at the temperature at which the dome is maintained, instead of passing into the worm and thence into the receiver, collect in drops upon the surface of the dome, and fall back upon the surface of the oil beneath, which has meantime become heated above their boiling points. Mr. Young distils the oils under pressure, thereby vapourising them at a temperature above their normal boiling points.

It is therefore obvious that the primary and essential condition of "cracking" is simply to subject the oils to a temperature above their boiling points, or in other words, to super-heat their vapours. It will be found that, for oils of the same density, the higher the temperature to which they are raised, or at which they are distilled, the lighter will be the product; and that to produce an oil of given density, the heavier oil must be raised to a certain fixed temperature, the intensity of heat depending on the lightness of the oil required.

Now it is evident that Prof. Silliman could not subject five or ten gallons of Maltha to experiment strictly analogous to Mr. Downer's process, the two elements of time and large capacity of apparatus being practically unattainable when manipulating so small a quantity. He could, however, follow Mr. Young's process strictly, using from 10 to 15 pounds pressure per square inch. My own results were obtained by using from 30 to 40 pounds pressure per square inch, and operating upon only 1,500 c.c. at a time.

Dr. Hirsch is correct in stating that during the distillation on the large scale, this process always obtains action in some degree, but his reasoning is utterly at fault. So, too, in his explanation of the fact, that "cracking" takes place in large stills, without any special effort to secure such a result. The real explanation lies in the fact, that the upper portion of stills in ordinary use is generally exposed to atmospheric currents and radiation. With such an arrangement it is impossible, upon Mr. Downer's plan, to prevent more or less condensation upon the dome, and consequent "cracking," especially toward the end of the operation, in stills of the enormous capacity of 40,000 gallons, where all the conditions essential to his process are present. It was in stills set in this manner that the heavy California oils were first distilled, and in which they were "cracked" to an oil of medium density; but when the sides and domes of the stills were surrounded with brickwork, the vapours were no longer condensed, and they passed unchanged into the receiver.

Dr. Hirsch is again in error in supposing that paraffine oils are produced by a high temperature. I am told that Mr. Downer has made illuminating oils, by "cracking" solid paraffine wax by means of his process. The paraffine lubricating oils of commerce are now most successfully produced from coals, by distilling the material in large kilns, in which combustion takes place at the upper surface, and the draft is conducted downward, insuring the expulsion of the volatile products at the very lowest temperature possible.

He is yet again in error in the analogy which he assumes to exist between rapid and slow distillation of petroleum and the distillation of coals in small retorts to produce illuminating gas, and in revolving retorts to produce oil. Rapid distillation "cracks" the oil, because it necessitates increased temperature to force the vapours from the still. Such has been my experience repeatedly on both the large and small scale. Slow distillation yields the hydrocarbons unchanged, provided the vapours have ready egress from the still, because distillation is then carried on at the lowest temperature attainable. Small retorts are used for the manufacture of gas, in order that the coal may the sooner be raised to the red-heat, and the greatest possible "cracking" effect be experienced, while revolving retorts are used for the manufacture of oil, not that the charge may be repeatedly cooled, but in order that it may be uniformly heated, avoiding the necessity of overheating the portion next the fire, in order that the upper portion may be heated sufficiently.

His first and second rules, when reduced to plain English, assert that "cracking" may be produced by refrigeration. Following their lead, in order to produce from paraffine wax the lightest member of the naphtha series isolated by Prof. Warren, and boiling at 0°C ., the paraffine should be immersed in melting ice. According to these rules, the best method of producing illuminating gas from crude petroleum would be to subject the oils to the action of a refrigerating mixture

of solid carbonic acid and ether, instead of allowing them to drip upon red-hot coke.

His third rule is correct, as the lower the temperature at which the top of the still is maintained, the lower will be the boiling point of the liquid resulting from the condensation of the vapours that escape.

His fourth rule is too obscure in its signification to admit of criticism.

His fifth rule is of the most extraordinary character. Chemistry is not yet ready for the announcement of the transmutation of one element into another, and such transmutation must certainly take place if water can be produced by distillation of volatile hydrocarbons, with exclusion of oxygen. So, too, is it almost equally difficult to imagine how any general laws can be "the same" for two processes so diametrically opposed as distillation in a vacuum and under pressure.

I desire in this connection to note a few suggestions which have occurred to me in reference to this subject. In the last edition of Prof. Dana's *Mineralogy* (1868), he has classified the results obtained by Profs. Warren and Storer, and arranged the hydrocarbons isolated by them in three groups, viz., the Naphtha and Beta-naphtha series, and the Pittoleum group. The first two are isomeric, the last contains more carbon in proportion to its hydrogen. The members of the Pittoleum group at present isolated are doubtless the lower members of a large group, the higher members of which have very high boiling points; or perhaps still there is another group containing a still larger proportion of carbon. As the different members of these groups decrease in density, the proportion of hydrogen increases, and as they increase in density the proportion of carbon increases. The process of "cracking" Pennsylvania oils, therefore, is simply subtraction of carbon; and it appears from the results of experiment and analysis, that each additional atom of carbon is held by a feeble affinity than the last, consequently the stability of the members increases as the proportion of carbon decreases. The lower the member is in the series, the stronger is the affinity of the hydrogen for the carbon, and consequently, the higher is the temperature required for the production of the member next below it. Thus it is that overheating dense paraffine oils produces medium or illuminating oils; overheating illuminating oils produces still lower and more volatile liquids; at a still higher temperature the products become gaseous, and at an excessively high temperature, light rather than heavy carburetted hydrogen gas is produced.

In the absence of actual demonstration by fractionation, I am led to believe from the behaviour of California petroleum, that they do not contain either the Naphtha or Beta-naphtha series in appreciable quantity; nor do they contain the members of the Pittoleum group yet isolated in large proportion, but are doubtless made up of the higher members of that group, or a still more highly carbonised and unstable group not yet described, with which is mingled one or more nitrohydrocarbons yet more easily decomposed. Be this fact or fancy, the appearance and physical properties of the refined pressure distillate from these oils, lead to the opinion that it is made up of the same members of which refined Pennsylvania petroleum is composed. The lightest oils existing in crude California petroleum change in a few weeks, after treatment, to a dirty yellow colour, even when tightly corked and exposed only to the light. A bottle of refined pressure distillate in my possession has now been prepared nearly two years, yet its colour has scarcely changed perceptibly.

By Prof. Warren's process of fractionation only a trace was eliminated from any of my samples of crude California oil under 150° C., yet in one instance, when my valve accidentally stuck so that the pressure was very considerably increased above 40 pounds, the vapours when they escaped passed through the worm uncondensed at 8° C., and melted the lead pipe at its point of connection with the retort; proving that, as in the case of the heavy paraffine oils, decrease in the density of the distillate follows any considerable increase in the temperature of distillation.

I hope at some future day to be able to fractionate both the crude California petroleum, and the products of their distillation under pressure, and thus obtain some additional facts in reference to this interesting question. —*American Journal of Science, January, 1869.*

ON THE ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.*

In that portion of central Germany known as the Mansfeld District, there is found a vein containing metallic ore, which is worked for copper and silver. Since, generally speaking, this ore is extremely variable in value, and since it becomes more and more a matter of immense importance to be able to judge without loss of time of the quantity of metal contained in the ore brought up from various portions of the mines, the want of good means for ascertaining this speedily was more and more felt. It need hardly be said that there exist a great many methods for the quantitative estimation of copper in its various combinations; but it is equally true that only very few of these are fit for technical application; it being moreover especially desirable that persons not professional assayers or chemists, but miners† of ordinary intelligence, should be enabled to make the required assays. In the laboratory of the mine owners at Eisleben there has been in use for the poorer copper ores a method of assaying introduced by the late H. Rose, while the raw products of the furnaces were assayed according to a Swedish method. The objection against both these methods, which were executed by fitly educated men, was, that for a large number of assays, such as are daily required to be finished there, it took too much time, too much room, and too many hands and apparatus. Rose's method just alluded to is the following: the finely powdered ore is acted on by aqua regia, to which some sulphuric acid is added; next, evaporation to dryness, dissolving in acidulated water, separation of the copper by means of sulphuretted hydrogen, and weighing the sulphide of copper after having been ignited and cooled in a current of hydrogen gas. Although the method here described is a good one, it implies for correctness the condition that no metals precipitable by sulphuretted hydrogen, and non-volatile when ignited in a current of hydrogen, be present. As regards the Mansfeld ores, the absence of such metals has been over and over again proved; but for all this, it appears that now and then small quantities of molybdenum have affected the correctness of the results. The Swedish method, however excellent its results, is very cumbersome, and embraces too many different operations to admit of

being very readily and thoroughly mastered by many operators.

The difficulty as regards the Swedish method is the precipitation of the metallic copper: the solution from which it takes place, by means of metallic iron, should neither be too hot nor too cold; a too large excess of acid also is objectionable. It requires, moreover, a special tact to see when all the copper has been precipitated, since the iron must then be removed from the solution at once, and the acid solution decanted from the copper; in one word, with the greatest possible care it was not very easy to work the two methods just briefly alluded to, with operators who were not specially educated for such work.

Under these circumstances, the directors of the Mansfeld copper mines issued, in May, 1867, the following advertisement in four scientific German papers:—"A premium of 300 thalers (£45) will be granted to the party who discovers a method of assaying the Mansfeld copper ores, provided the following conditions are complied with:—(a) the assay, and all the operations belonging thereto, must not take longer time than from five to six hours; (b) one man must be enabled to execute daily eighteen assays, without too great a strain upon his faculties; (c) the limits of accuracy must be strictly kept within the following amounts:—for minerals containing 1 pound of copper to the hundred-weight, 10 per cent; for 2 pounds to the hundred-weight, 6; for 3 pounds, 5; for 4 pounds, 5; and above that figure, 4 per cent." It was moreover stated that the method to be given might be a combination of several methods already known.

Sixteen answers have been received by the directors. Six of the proposed methods were based on the volumetrical estimation of copper by means of cyanide of potassium or sulphide of sodium. One proposed method was based upon the estimation of iodine previously set free, by means of hyposulphite of soda; one titration with solution of iodine; one titration with permanganate of potassa; one titration with xanthogenate of potassa; one determination of copper as oxide; two estimations of copper as sulphide, combined with ignition in current of hydrogen gas; two a so-called process of dry assay; one a process by electrolysis.

In order to select from this material, and report upon the best and most suitable plan, a committee of three gentlemen was appointed; two of them practical assayers and copper-smelters, the third the well-known Dr. Böttger. This committee decided—

(a). That any process which included many operations, and consequently took up too much time, should be excluded.

(b). No process to be admissible which involved the use of varying quantities of ore, since it is impossible to judge by the sight about the quality of the Mansfeld ore.

(c). Any process is also inadmissible wherein, for the burning off of the bituminous organic matter of the ore, more expensive substances, as, for instance, chlorate of potassa, are recommended.

(d). Any process is likewise inadmissible whereby the reactions take place with great violence, and may thus induce explosions.

(e). Such methods are inadmissible, also, wherein, for quantities of 5 grammes and more, is recommended the treatment with acids, and evaporation to dryness after addition of sulphuric acid.

(f). On sanitary grounds, and in reference to the

* Translated from the original German from the *Zeitschrift für Analytische Chemie von Fresenius*, 1869, No. 1.

† Miners in Germany are all men who must have enjoyed a good education, and all are under the orders and control of scientific and practical men as their superior officers.

large number of operations and assays daily required, such processes are also inadmissible wherein hyposulphite of soda is applied so that sulphurous acid is given off; while processes wherein large bulks of sulphuretted hydrogen are used are equally discarded.

(g). Methods whereby copper is separated from the earths, oxides of iron, and other metallic oxides, either by ammonia alone or in addition thereto of carbonate of ammonia, tartaric acid, &c., are also discarded; because the precipitated oxide of iron or alumina never fails to carry down some copper also; and, also, because oxides like those of zinc, nickel, and cobalt, by remaining in solution, affect the accuracy of the estimation of copper.

(h). Such estimations of copper are also discarded whereby it is collected in a spongy state, or as sulphide upon previously dried and weighed filters.

(i). The dry assay is also discarded, as, even if it were possible to obtain therewith correct results, it would entail in the consumption of fuel, breaking up of apparatus, crucibles, &c., and the use of various fluxes, a too great expenditure.

(k). Such processes are also discarded as require in the operator too much knowledge and scientific training.

(l). Such as require the aid of assistants are also discarded.

It is clear that many parties who had entered into the competition on this subject could not, owing to the severe conditions, remain in the field. The umpires instituted a large number of assays with divers samples of ores, which had been previously analysed, and the composition of which had been determined with rigorous accuracy, but had not been communicated to them. Their researches proved that, as regards the methods of volumetric estimation, only such deserve any confidence when the copper has been first previously separated in a metallic state, is next re-dissolved, and that then only the titration method with cyanide of potassium is a fit and serviceable one.

After a long series of experiments, the umpires decided in favour of Dr. Steinbeck's method in the first place, but were at the same time so satisfied about M. C. Luckow's plan, that to that gentleman, who holds the position of chief chemist to the Cologne-Minden Railway Company at Deutz, a premium has also been awarded. It may be briefly said here, that his method is based upon the estimation of copper by electrolysis.

Dr. Steinbeck's method, which entirely answers to the conditions published by the directors of the mines, embraces three distinct operations, viz.:—1. The extraction of the copper from the ore; 2. The separation; 3. The quantitative estimation of that metal.

I. The Extraction of the Copper from the Ore.

A proof centner, equal to 5 grammes of pulverised ore, is put into a flask, and there is poured over it a quantity of from 40 to 50 c.c. of crude hydrochloric acid, of a specific gravity of 1.16, whereby all carbonates are converted into chlorides, while carbonic acid is expelled. After awhile, there is added to the fluid in the flask 6 c.c. of a normal nitric acid, prepared by mixing equal bulks of water and pure nitric acid of 1.2 sp. gr. As regards certain ores, however, specially met with in the district of Mansfeld, some, having a very high percentage of sulphur and bitumen, have to be roasted previous to being subjected to this process; and others, again, require only 1 c.c. of nitric acid instead of 6. The flask containing the assay is digested on a well-arranged sand-bath for half an hour, and the con-

tents only boiled for about fifteen minutes, after which the whole of the copper occurring in the ore, and all other metals are in solution as chlorides. The blackish residue, consisting of sand and schist, has been proved by numerous experiments to be either entirely free from copper, or at the most only 0.01 to 0.03 per cent has been left undissolved.

The extraction of the copper from the ore, according to this method, is complete even in the case of the best quality of ore, which contains about 14 per cent of metal; while, at the same time, the very essential condition for the proper and complete separation of the metal, viz., the entire absence of nitric acid, or any of the lower degrees of oxidation of nitrogen, is fully complied with.

II. Separation of the Copper.

The solution of metallic and earthy chlorides, and some free hydrochloric acid, obtained as just described, is separated by filtration from the insoluble residue, and the fluid run into a covered beaker glass of about 400 c.c. capacity: in this beaker has been previously placed a rod of metallic zinc, weighing about 50 grammes, and fastened to a piece of stout platinum foil. The zinc to be used for this purpose should be as much as possible free from lead, and at any rate not contain more than from 0.1 to 0.3 per cent of the latter metal. The precipitation of the copper in the metallic state sets in already during the filtration of the warm and concentrated fluid, and is, owing especially also to the complete absence of nitric acid, completely finished in from half to three-quarters of an hour after the beginning of the filtration. If the fluid be tested with sulphuretted hydrogen, no trace even of copper will be detected; the spongy metal partly covers the platinum foil, partly floats about in the liquid, and, in case either the ore itself or the zinc applied in the experiment contained lead, small quantities of that metal will accompany the precipitated copper. After the excess of zinc (for an excess must be always employed) has been removed, the spongy metal is repeatedly and carefully washed by decantation with fresh water, which need not be distilled, and care taken to collect together every particle of the spongy mass.

III. Quantitative Estimation of the Precipitated Copper.

To the spongy metallic mass in the beaker-glass, wherein the platinum foil is left, since some of the metal adheres to it, 8 c.c. of the normal nitric acid are added, and the copper thus dissolved by the aid also of moderate heat, in the form of nitrate of copper, which, in the event of any small quantity of lead being present, will of course be contaminated with nitrate of lead.

When copper ores are dealt with, which contain above 6 per cent of copper, which may be somewhat judged from the rather larger bulk of the spongy mass of precipitated metal, 16 c.c. of nitric acid, instead of 8, are applied for dissolving the spongy metallic mass. The solution thus obtained is left to cool, and next mixed, immediately before titration, with cyanide of potassium, with 20 c.c. of normal solution of liquid ammonia, prepared by diluting 1 volume of liquid ammonia, sp. gr. 0.93, with 2 volumes of distilled water.

In the case of such ores as yield over 6 per cent of copper, and when a double quantity of normal nitric acid has consequently been employed, the solution in nitric acid is occupied by a bulk of 16 c.c. and is divided into two parts, each of which is separately

nia solution just alluded to, and the copper therein volumetrically determined. The deep blue-coloured solution of oxide of copper in ammonia only contains besides nitrate of ammonia, any lead which might have been dissolved having been precipitated as hydrated oxide of lead, which does not interfere with the titration with cyanide of potassium. The solution of the last-named salt is so arranged, that 1 c.c. thereof exactly indicates 0.005 grm. of copper. Since, for every assay, 5 grms. of ore have been taken, 1 c.c. of the titration fluid is, according to the following proportion:—

$$5 : 0.005 :: 100 : x = 0.1,$$

equal to 0.1 per cent. of copper; it hence follows that, by multiplying the number of the c.c. of cyanide of potassium solution used to make the blue colour of the copper solution disappear, by 0.1, immediately indicates the percentage of copper contained in the ore.

As may be imagined, at the laboratory of the mine-owners at Eisleben, such a large number of assays are daily executed that, in this case, there can be no reason to fear a deterioration of the cyanide solution, of which large quantities are used and often fresh made; but, for security's sake, the solutions are purposely tested for control at least once every week. According to the described plan, six assays can be made within 4 hours; and during a working day of from 7½ to 8 hours, twenty assays have been often made quite satisfactorily by the umpires, as well as the workmen at Eisleben.

Some Special Observations on the Volumetric Estimation of Copper by means of Cyanide of Potassium, bearing upon the Method just described.

Dr. Steinbeck considered it necessary to test his method specially, in order to see what influence is exercised thereupon by (1) nitrate of ammonia, (2) caustic ammonia, (3) presence of oxide of lead. The copper used to perform the experiments for this purpose was pure metal, obtained by galvanoplastic action, and was ignited to destroy any organic matter which might accidentally adhere to it, and, next, cleaned by placing it in dilute nitric acid. Five grammes of this metal were placed in a litre flask, and dissolved in 266.6 c.c. of normal nitric acid, the flask and contents gently heated, and, after cooling, the contents diluted with water, and thus brought to a bulk of 1000 c.c. exactly. Thirty c.c. of this solution were always applied to test and titrate one and the same solution of cyanide of potassium under all circumstances. When 5 grammes of ore, containing on an average 3 per cent. of copper, are taken for assay, that quantity of copper is exactly equal to 0.150 gramme of the chemically pure copper. The quantity of normal nitric acid taken to dissolve 5 grammes of pure copper (266.6 c.c.), was purposely so taken, as to correspond with the quantity of 8 c.c. of normal nitric acid, which is applied in the assay of the copper obtained from the ore, and this quantity of acid is exactly met with in 30 c.c. of the solution of pure copper.

As regards No. 1 and No. 2 (see above), the influence of double quantities of nitrate of ammonia and free caustic ammonia (the quantity of copper remaining the same), and the action of dilute solution of cyanide of potassium thereupon, will become elucidated by the following facts:—

(a). Thirty c.c. of the normal solution of copper, containing exactly 0.150 gramme of copper, were rendered alkaline with 10 c.c. of normal ammonia, and are found to require, for entire decolouration, 29.8 c.c. of cyanide of potassium solution; a second experiment, again

with 30 c.c. of normal copper solution, and otherwise under identically the same conditions, required 29.9 c.c. of cyanide solution. The average of the two experiments is 29.85 c.c.

(b). When to 30 c.c. of the normal copper solution first 8 c.c. of normal nitric acid are added, and then 20 c.c. of normal ammonia solution, instead of only 8, whereby the quantity of free ammonia and of nitrate of ammonia is made double what it was in the case of the experiments spoken of under a, there is required of the very same cyanide solution 30.3 c.c. to produce decolouration. A repetition of the experiment, exactly under the same conditions, gave 30.4 c.c. of the cyanide solution employed; the average of both experiments is, therefore, 30.35 c.c.

The difference between 30.35 and 29.85 is equal to 0.5 c.c., and that figure is therefore the coefficient of the influence of double quantities; and supposing this to happen with the ores in question, it would only be equivalent to 0.05 per cent. of metallic copper. It is hence clear that slight aberrations of from 0.1 to 0.5 c.c. in the measuring out of 8 c.c. of normal nitric acid, used to dissolve the spongy copper, and of 10 c.c. of normal ammonia, in order to render that nitric acid copper solution alkaline, is of no consequence whatever for the technical results to be deducted from the assay; it should be, moreover, borne in mind that the quantities of free ammonia and of nitrate of ammonia, in the actual assay of ores, for which always a quantity of 5 grammes of ore is taken, varies according to the richness or poverty of the ores in copper; and the quotation of the following results of experiments prove that the influence of these substances is only very slightly felt affecting the accuracy of the results:—

Eight c.c. of the normal nitric acid have been found to contain, by means of a series of experiments, 1.353 grammes of anhydrous nitric acid; and this quantity of acid is exactly neutralized by 7.7 c.c. of normal ammonia solution, which contains 0.6515 gramme of oxide of ammonium; and 10 c.c. of the said normal solution contain 0.846 gramme of oxide of ammonium.

One gramme of metallic copper requires, for complete oxidation, 0.2523 gramme of oxygen, and this quantity of oxygen is given off by 0.5676 gramme of anhydrous nitric acid; while, at the same time, binoxide of nitrogen is disengaged. From these data can be calculated (1) the quantity of nitric acid which becomes decomposed when variable quantities of metallic copper are dissolved therein, (2) what quantity of nitric acid is left to form neutral nitrate of ammonia, and (3) what quantity of free ammonia will be left after a portion of that alkali has been combined with, and therefore neutralised by, oxide of copper, and any remaining free nitric acid. The following figures exhibit these variations:—

Containing copper.	From Ores.	From 1.353 grms. of anhydrous nitric acid, equal to 8 c.c. of normal nitric acid,			From 0.846 grm. of N H ₄ O, as met with in 10 c.c. of normal solution of N H ₃ , remain capable of forming ammoniacal oxide of copper,
		When 5 grms. were taken for assay, were obtained of copper.	Become decomposed by the dissolution of the copper.	Remain, so as to be capable of forming nitrate of ammonia.	
Per cent.	Grms.	Grms.	Grms.	Grms.	Grms.
1	0.050	0.028	1.325	0.208	
2	0.100	0.056	1.296	0.222	
3	0.150	0.085	1.268	0.235	
4	0.200	0.113	1.240	0.249	
5	0.250	0.142	1.211	0.263	
6	0.300	0.170	1.183	0.276	

It will be readily seen that the quantitative aberrations between ores containing 1 per cent or 6 per cent of metal, vary very little from the normal quantities exhibited by ores containing 3 per cent of metal. The relation is as 1 : 2; and, for technical purposes, this has been proved not to be a disturbing quantity.

When, however, larger quantities of ammoniacal salts are present in the fluid to be assayed for copper, by means of a titrated solution of cyanide of potassium, and especially when carbonate, sulphate, and, worse still, hydrochlorate, of ammonia are simultaneously present, these salts exert a very disturbing influence, as fully discussed in Fresenius's "Handbook of Analytical Chemistry," to which the reader is therefore referred. The presence of oxide of lead in the copper solution to be assayed has the effect of producing, on the addition of ammonia, 10 c.c. of normal ammonia, a milkiness along with the blue tint; but the presence of this oxide does not at all interfere with the estimation of the copper by means of the cyanide, provided the lead be not in great excess; and a slight milkiness of the solution even promotes the visibility of the approaching end of the operation.

Dr. Steinbeck has, however, purposely made some experiments to test this point, and his results are as follows:—He first prepared a solution of metallic lead in as little nitric acid as possible; and next diluted that solution, so that 1 c.c. thereof contained 0.0075 gramme of lead; with that solution the following experiments were made:—

(a). Thirty c.c. of normal copper solution, containing 0.150 gramme of copper, and 10 c.c. of normal ammonia solution, required, for complete decolouration, 29.9 c.c. of solution of cyanide of potassium.

(b). Thirty c.c. of the same solution as *a*, and in addition thereto 2 c.c. of solution of lead, containing 0.015 gramme of lead, equal to 10 per cent upon the quantity of copper, required of cyanide solution 30.0 c.c.

(c). Thirty c.c., as above under *a*, and addition thereto of 4 c.c. of solution of lead, containing 0.030 gramme of lead, equal to 20 per cent upon the quantity of copper, required of cyanide solution 29.9 c.c.

(d). Thirty c.c., again as above under *a*, and addition thereto of 10 c.c. of solution of lead, containing 0.075 gramme of lead, equal to 50 per cent upon the quantity of copper, required of cyanide solution 30.0 c.c.

(e). Thirty c.c. of copper solution again, and addition thereto of 20 c.c. of solution of lead, containing 0.15 gramme of lead, equal to 100 per cent upon the quantity of copper, required of cyanide solution 30.1 c.c.

Since neither 50 nor 100 per cent of addition of lead exerts any perceptible influence upon the estimation of copper from its ores, or otherwise, by means of cyanide of potassium, a small quantity of accidentally occurring lead will not affect the results, and this the less so, as, generally, no ores of both metals occur together, wherein both are met in sufficient quantity to make it worth while working the ore for both metals at the same time.

Since it is well known that the presence of zinc very perceptibly influences the action of a solution of cyanide of potassium, when applied to the volumetrical estimation of copper, Dr. Steinbeck considered it necessary to institute some experiments, in order precisely to ascertain, with what quantity of zinc present along with copper, this influence commences to become perceptible. The solution of zinc applied was made by dissolving the metal in the smallest possible quantity of nitric acid; and 1 c.c. of that solution contained 0.001 gramme of

zinc. The results of the experiments recorded in the following tabulated form were made with this solution of zinc:—

Copper Solution.	Normal Ammonia.	Zinc Solution.	Percentage upon Copper.	Solution of Cyanide required.
c.c.	Copper in grms.	c.c.	Zinc in grms.	c.c.
30	0.150	10	—	30.00
30	0.150	10	1.5	30.00
30	0.150	10	3.0	30.10
30	0.150	10	4.5	30.00
30	0.150	10	6.0	30.00
30	0.150	10	7.5	30.05
30	0.150	10	10.5	30.60
30	0.150	10	10.5	30.60
30	0.150	10	15.0	30.90
30	0.150	10	22.5	31.20

The presence of zinc does not interfere with the visibility of the end of the reaction, viz., the decolouration of the copper solution. The results of the experiments herewith quoted prove that a small quantity of zinc, less than five per cent of the quantity of copper present, or 0.0075 gramme by weight of zinc, does not at all affect the action of the solution of cyanide of potassium; but when the quantity of zinc increases, a very perceptible effect is seen upon the solution of cyanide; it is therefore necessary to bestow due care while washing the spongy copper, after it has been precipitated by means of zinc from its solution (see above, under II.).

Since it has been ascertained that the action of solution of cyanide of potassium in researches of this kind is also affected by an increased temperature of the solution of copper which is to be titrated therewith, it is strictly necessary never to operate with warm solutions of ammoniacal copper, but to suffer the same to cool down to the ordinary temperature of the air of the laboratory.

While 30 c.c. of copper solution, containing 0.15 gramme of copper, and 10 c.c. of normal ammonia solution, required, at the ordinary temperature, 30.0 c.c. of cyanide solution; the same quantities required, at between 40° to 45° C., 28.8 c.c. of solution of cyanide; and at 45° C., 28.9 c.c. of the same solution, thus proving the injurious effect of warm solutions.

(To be continued.)

ON THE FORMATION AND PHENOMENA OF CLOUDS.*

BY J. TYNDALL, LL.D., F.R.S.

It is well known that when a receiver filled with ordinary undried air is exhausted, a cloudiness, due to the precipitation of aqueous vapour diffused in the air, is produced by the first few strokes of the pump. It is, as might be expected, possible to produce clouds in this way with the vapours of other liquids than water.

In the course of some experiments on the chemical action of light, I had frequent occasion to observe the precipitation of such clouds in the experimental tubes employed. The clouds were generated in two ways. One mode consisted in opening the passage between the filled experimental tube and the air-pump, and then simply dilating the air by working the pump. In the other, the experimental tube was connected with a vessel of suitable size, while the passage between the

* Abstract of a paper communicated to the Royal Society, January 25th, 1869.

vessel and tube could be closed by a stopcock. The vessel was first exhausted. Turning on the cock the air rushed from the experimental tube into the vessel, the precipitation of a cloud within the tube being a consequence of the transfer.

The clouds thus precipitated differed from each other in luminous energy, which is, of course, to be referred to the different reflective energies of the particles of the clouds, which were produced by substances of very different refractive indices.

Different clouds, moreover, possess very different degrees of stability. Some melt away rapidly, while others linger for minutes in the experimental tube, resting upon its bottom as they dissolve like a heap of snow.

The clouds exhibit a difference in texture. A certain expansion is necessary to bring down the cloud. The moment before precipitation, the mass of cooling air and vapour may be regarded as divided into a number of polyhedra, the particles along the bounding surfaces of which move in opposite directions when precipitation actually sets in.

Every cloud-particle has consumed a polyhedron of vapour in its formation; and it is manifest that the size of the particle must depend, not only on the size of the vapour polyhedron, but also on the relation of the density of the vapour to that of its liquid. If the vapour were light and the liquid heavy, other things being equal, the cloud-particle would be smaller than if the vapour were heavy and the liquid light.

The case of toluol may be taken as representative of a great number of others. The specific gravity of this liquid is 0.85; water being 1.0, the specific gravity of its vapour is 3.26, that of aqueous vapour being 0.6. Now, as the size of the cloud-particle is directly proportional to the specific gravity of the vapour, and inversely proportional to the specific gravity of the liquid, an easy calculation proves that, assuming the size of the vapour polyhedra in both cases to be the same, the size of the particle of toluol cloud must be more than six times that of the particle of aqueous cloud. Aqueous vapour is without parallel in these particulars—it is not only the lightest of all vapours, but also the lightest of all gases, except hydrogen and ammonia. To this circumstance the soft and tender beauty of the clouds of an atmosphere is mainly to be ascribed.

The sphericity of the cloud-particles may be inferred from their deportment under the luminous beams. The light which they shed when spherical is continuous, but clouds may also be precipitated in solid flakes, and then the incessant sparkling of the cloud shows that its particles are plates, and not spheres. Some portions of the same cloud may be composed of spherical particles, others of flakes, the difference being at once manifested through the calmness of one portion of the cloud and the uneasiness of the other.

ON THE CHEMICAL FORMULA OF ALIZARINE.

BY EDWARD SCHUNCK, PH.D., F.R.S., &C.

THE discovery of a mode of preparing alizarine artificially, lately made by MM. Graebe and Liebermann, and brought before the notice of the Society at its last meeting by Professor Roscoe, is not only of the highest importance from a practical point of view, but is also of great interest as being the first recorded instance of the artificial formation of a natural colouring matter.

The formula to which I was led in my examination of the colouring matters of madder, viz., $C_{14}H_{10}O_4$, approaches very closely, as Professor Roscoe observed, to the one now adopted by Graebe and Liebermann, $C_{14}H_8O_4$. My formula was not founded on theoretical views but simply expressed the composition to which my numerous analyses of alizarine and its compounds conducted. I have until now seen no reason whatever to adopt any other, notwithstanding that Strecker's formula, $C_{16}H_8O_4$, has been preferred by most chemists, and was even pronounced by Laurent to be the only one possible. That my analyses do not in the least correspond with the latter formula, but are not inconsistent with that of Graebe and Liebermann, will be seen by a glance at the following numerical results of some analyses of alizarine from various sources:—

	I.	II.	III.	IV.	V.	Mean.
C.....	69.15	69.37	69.59	69.66	69.73	69.50
H.....	4.04	4.07	4.26	4.00	3.71	4.01
O.....	26.81	26.56	26.15	26.34	26.56	26.49

Of these analyses, I. was made with material obtained directly from madder, II. and III. with specimens derived from rubian by decomposition with acid and with ferment, IV. with alizarine from rubianic acid (its glucoside), and V. with sublimed alizarine. The three formulae, $C_{14}H_8O_4$, $C_{14}H_{10}O_4$, and $C_{16}H_8O_4$, require the following percentages of C, H, and O.

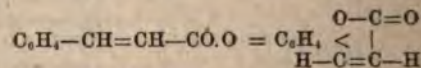
	$C_{14}H_8O_4$.	$C_{14}H_{10}O_4$.	$C_{16}H_8O_4$.
C.....	70.00	69.42	68.96
H.....	3.33	4.13	3.45
O.....	26.67	26.45	27.59

It will be seen that my results are not reconcilable with the last formula, whereas in some cases, especially in that of sublimed alizarine, the composition found agrees tolerably well with the new formula, $C_{14}H_{10}O_4$. The great excess of hydrogen found even in the case of well-crystallised and apparently quite pure alizarine remains to be explained, and though unwilling to throw any doubt on the complete identity of the natural and artificial product, I confess I look forward with great interest to the full confirmation of this remarkable discovery.

ON THE CONSTITUTION OF COUMARIN AND COUMARIC ACID.

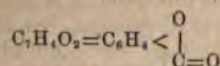
BY PROF. RUDOLPH FITTIG.

At the meeting of the Chemical Society, held April 1st, Mr. Perkin stated that my views on the constitution of coumarin could not be correct, inasmuch as coumarin has not the properties of an anhydride. I cannot consider the objections either of Mr. Perkin or of Prof. Williamson as conclusive. Coumarin certainly conducts itself in an entirely different manner from lactide and other anhydrides of the fatty series; but it does not belong to this series; on the contrary, it is a derivative of benzol. The formula proposed by me (*CHEMICAL NEWS*, vol. xix., page 73, *Am. Repr.*, April, 1869, page 180),



shows that one of the oxygen atoms unites the third atom of carbon of the chain $CH=CH-CO$ with the benzol residue, C_6H_5 . A chain of this sort, just as all aromatic compounds, must be much more stable than similar bodies of the fatty group. But the properties

of the fatty anhydrides also are not the same, the one is much more stable than the other. Acetic anhydride is suddenly decomposed by water and alcohol, succinic anhydride is not attacked by cold water, and lactide can be recrystallised from hot alcohol without decomposition. We are furthermore acquainted with an aromatic body of similar constitution, salicylide,



obtained by Gerhardt from salicylate of sodium and oxychloride of phosphorus, which shows, although not the same, still a stability very similar to that of coumarin. Boiling with water and carbonate of sodium produces no effect upon it. Ammonia acts upon it even at the boiling temperature extremely slowly. Heating with caustic potassa converts it into salicylic acid. Coumarin conducts itself in the same way. It is converted into coumaric acid even at 40–60° C., through the influence of dilute alkalis, as has been proved by Zwenger. Perkin says, "it was not an easy matter to produce coumaric acid from coumarin." This arises apparently from the fact that he used too concentrated solutions of potassa, which makes coumarin more stable, as Zwenger has already observed (*Ann. Chem. Pharm.*, Suppl., 5, 122).

The fact that coumarin occurs in plants in presence of water—in most cases together with coumaric acid (Zwenger)—can so much the less be regarded as proof, as other anhydrides occur in nature. Many resins are, as is known, such anhydrides of acids.

Concerning the negative results of Mr. Perkin in the repetition of Bertagnini's experiment on the artificial formation of cinnamic acid from the oil of bitter almonds and chloride of acetyl, I will merely mention that Kraut (*Ann. Chem. Pharm.*, 147, 111) has also repeated this experiment, and has found that the acid obtained in this way is in every respect identical with cinnamic acid. I will also add, that a short time ago, one of my pupils, Mr. Bieber, by means of the same reaction, from oil of bitter almonds and chloride of butyryle, at 130° C., prepared an acid, $\text{C}_{11}\text{H}_{12}\text{O}_2 = \text{C}_6\text{H}_5\text{C}_4\text{H}_7\text{COHO}$ (phenyl-angelica-acid), which is homologous with cinnamic acid, and very similar to it. It melts at 81°, is difficultly soluble in water, and gives a barium and calcium salt, which are also somewhat difficultly soluble in cold water.

Göttingen, April 16th, 1869.

VEGETABLE ELECTROMOTORS.

BY EDWIN SMITH, M.A.

It is well known that a voltaic combination may be made of two liquids and a metal, if one of the three acts chemically upon one, and only one, of the other two; thus—we may employ copper, nitrate of copper, and dilute nitric acid; or platinum, potash, and nitric acid. Connect a platinum crucible with one terminal of a galvanometer, pour in a little solution of caustic potash, place in this the bowl of a tobacco-pipe having the hole stopped up with wax, pour into the bowl a little nitric acid, dip in the acid a small slip of platinum foil, and connect this with the other terminal of the galvanometer; a powerful deflection of the needle indicates the presence of an electric current, and shows its direction to be from the alkali to the acid, the platinum serving merely as a conductor. It occurred to me, when performing this experiment, that an electro-mo-

tive combination might just as well be made of two vegetable substances, with platinum for conductor, provided only they were of a nature to act chemically upon one another—an alkaloid and an organic acid, for instance. It also seemed to me not unlikely that, wherever two flavours are habitually conjoined in our cookery and eating, the reason why they mutually improve each other is because a certain amount of electric action is set up between the substances employed to produce them. The rationale of the right blending of flavours might be found partly, no doubt, in chemistry, but partly, also, in galvanism.

Pursuing this idea, I tried pairs of eatables which generally go together, such as pepper and salt, coffee and sugar, almonds and raisins, and the like, and found that a voltaic current more or less strong was excited in every instance which I tested. Bitters and sweets, pungents and salts, or bitters and acids, generally appear to furnish true voltaic couples, doubtless in consequence of the mutual action of some alkaloid salt and an acid or its equivalent. As others may like to repeat or extend the experiments, I will describe shortly my mode of procedure:—Cut two pieces of platinum foil about 5 in. by 2½ in., and a number of pieces of filter-paper a trifle larger. Well-washed linen is sometimes more convenient than filter-paper. Have a small wooden board near the mercury cups of the galvanometer, and let a short copper or platinum wire, dipping into one of the cups, rest on the board. The substances to be tried must be brought to a state of solution, the stronger the better, by infusion, decoction, or otherwise. Suppose coffee and sugar are to be operated upon; solutions of both having been prepared, dip into each a slip of filter-paper; place one slip on one of the pieces of platinum foil, and the other on the second piece. Next lay the first slip and its foil on the board, with the metal touching the copper wire before mentioned. Lay the second slip with its platinum upwards, so that the coffee and sugar come into even contact with slight pressure, and immediately connect this upper slip, through a bit of copper wire, insulated from the touch, with the other terminal of the galvanometer. Deflection occurs instantaneously, and may be increased to a considerable vibration by breaking and making circuit at the right swing of the needle. After a few distinct vibrations, it is well to turn over the whole pile of slips just as they are, and connect opposite ends with the galvanometer, so as to reverse the current. This is desirable for the sake of confirming your previous observation, and of correcting any slight disturbing cause arising from the wire and mercury connectors, temperature of the hand, and so forth. It will be found that coffee and sugar have the same electrical relation to each other as zinc and platinum. Coffee, in fact, is the positive, sugar the negative element. I subjoin a table of the results of numerous experiments, conducted in the manner above described.

ELECTRO-POSITIVE.	ELECTRO-NEGATIVE.
Coffee.....	Sugar (loaf).
Tea (black).....	"
Cocoa.....	"
Nutmeg.....	"
Cloves.....	"
Cinnamon.....	"
Mace.....	"
Vanilla.....	"
Almonds.....	"
Rhubarb (tincture).....	"
Starch.....	
Starch caramel.....	

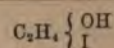
ELECTRO-POSITIVE.	ELECTRO-NEGATIVE.
Gum caramel.....	Sugar (loaf).
Cane sugar caramel.....	"
Milk sugar.....	"
Gum.....	"
Almonds.....	Raisins.
Horseradish.....	Beetroot.
Onion.....	"
Horseradish.....	Table salt.
Mustard.....	"
Pepper (white).....	"
Mustard.....	Tartaric Acid.
Ginger.....	"
Cayenne pepper.....	"
Pepper (white).....	"
Tea (black).....	"
Tobacco.....	"
Quinine (Howard's).....	"
Gentian root.....	"
Lemon juice.....	"
Horehound.....	"
Lavender water.....	"
Quassia.....	"
Peppermint.....	"
Raw potato.....	Lemon juice.
Rind of lemon.....	"
Peruvian bark.....	"
Camphor (tincture).....	"
Laudanum.....	"
Arnica (tincture).....	Dilute Sulphuric Acid.
Peruvian bark.....	"
Quinine (Howard's).....	"
Iodine (tincture).....	Turpentine.
Caustic potash.....	"
Starch.....	"
Starch.....	Iodine (tincture).
Caustic potash.....	Neat's-foot oil.

It is somewhat difficult to eliminate from these experiments all error arising from difference of temperature, if the galvanometer is tolerably sensitive. Care must be taken to bring the pair of solutions operated upon to the same temperature before testing them; otherwise a thermo-electric current from the hotter to the colder liquid may affect the needle, and mask the true electrical relation between the two, so far as it depends upon their chemical nature.

ON THE DERIVATIVES OF PROPANE (HYDRIDE OF PROPYL).*

BY C. SCHORLEMMER.

At the time when I commenced this investigation, the existence of normal propyl alcohol was very doubtful. According to Chancel,† this body is found in the fusel oil from the marc of grapes, but Mendeleeff‡ tried in vain to isolate it from a sample of this oil which he had obtained from Chancel himself. Several attempts to prepare the normal alcohol by synthesis failed. Thus Linnemann and Siersch§ tried to obtain it by converting acetonitril into propylamine, by means of hydrogen in the nascent state, and decomposing the hydrochlorate of this base with silver nitrite, but the alcohol thus formed was found to be the secondary one. The same compound was obtained by Butlerow and Ossokin,§ by acting upon ethylene iodohydrine,



with zinc methyl, in order to replace iodine by methyl. Now as in both cases, according to theory, the normal or primary alcohol ought to have been formed, and as we have no explanation why instead of this compound the secondary alcohol was obtained, Butlerow and Ossokin believe that the normal propyl alcohol cannot exist. Not agreeing with this view, I was led to an investigation of this subject, the results of which I have the honour to lay before the Society.

My reasoning was as follows:—It appears, as the most probable theory, and which is now accepted by most chemists, that the four combining powers of the carbon atom have the same value. If so, only one hydrocarbon having the composition C_3H_8 can exist. This propane must be formed by replacing in the secondary propyl iodide, the iodine by hydrogen, and subjecting the hydrocarbon thus obtained to the action of chlorine, by which primary propyl chloride must be formed in accordance with the behaviour of other hydrocarbons of the same series.

I soon found that my theory was correct; and in a short note, which I published in *Zeitschrift für Chemie* (1868, p. 49), I stated that I had obtained the normal propyl alcohol by this method. At the same time, Fittig proved that it was contained in fusel-oils,* and lately, Linnemann prepared it synthetically from ethyl-compounds by converting acetonitrile (ethyl cyanide) into propionic anhydride, and acting upon this body with nascent hydrogen.†

The propane which I used in my researches was obtained by acting upon isopropyl iodide with zinc turnings and diluted hydrochloric acid. A continuous evolution of gas takes place if the flask containing the mixture is kept cold. If it is not cooled down a violent reaction soon sets in. The gas always contains vapour of the iodide, even if it has been evolved very slowly. In order to purify it as much as possible, it was washed with Nordhausen sulphuric acid, with a mixture of nitric and sulphuric acids, and with caustic soda solution.

As a gas-holder I used a tubulated bell-jar, which was suspended in a larger inverted one, filled with a concentrated solution of common salt. When a sufficient quantity of gas had collected, chlorine was passed into it, care being taken not to have it in excess. In diffused daylight substitution products were formed, which collected as an oily layer on the salt solution. Alternately more propane and chlorine were passed into the apparatus, until it was nearly filled with the excess of propane and vapours of the most volatile substitution products. The latter were condensed by passing the gas into a receiver surrounded by a freezing mixture. To collect the liquid chlorides which were contained in the gas-holder, the tubulus of the bell-jar was closed with cork, which was provided with a wide short glass tube, open at both ends, and so much salt solution put into the gas-holder that the chlorides entered this tube, from which they could easily be removed with a pipette. By repeating this process several times, a quantity of chlorine compounds, sufficient for further investigation, was obtained. This was washed with water, dried over caustic potash, and distilled. The liquid commenced to boil at 42°C ., the boiling point rising towards the end above 200°C . By

* Read before the Royal Society, April 8th, 1869.

† *Comptes Rendus*, vol. xxxvii., p. 410.

‡ *Zeitschrift für Chemie*, 1868, p. 25.

§ *Annalen Chem. Pharm.*, vol. cxlv., p. 237.

§ *Annalen Chem. Pharm.*, vol. cxlv., p. 257.

* *Zeitschrift f. Chemie*, 1868, p. 44.

† *Annalen Chem. Pharm.*, vol. cxlviii., p. 251.

fractional distillation, a comparatively small quantity of liquid was obtained, which boiled at 42° – 46° , and consisted of the primary propyl chloride, C_3H_7Cl .

0.0975 of this chloride gave 0.1730 silver chloride, and 0.005 silver, corresponding to 0.044 chlorine.

Calculated for C_3H_7Cl .

Found.

45.2 per cent Cl.

45.5 per cent Cl.

In order to prove that this body was really the normal chloride, it had to be converted into the alcohol. For this purpose I used that portion of the chlorides which, after repeated distillation, boiled below 80° C. It was heated in sealed tubes with potassium acetate and glacial acetic acid for several hours to 200° C., and thus converted into the acetate, a light colourless liquid, possessing the characteristic odour of the acetic ethers. I did not endeavour to obtain this ether in the pure state, as this could have been only effected with great loss of material, but converted it at once into the alcohol, by heating it with a diluted solution of potash, in sealed tubes, up to 120° C. After cooling, the contents of the tubes were distilled and rectified. A portion of it was oxidised with a cold dilute solution of chromic acid. No gas was evolved, but a strong smell of aldehyd was perceived, which disappeared on adding more chromic acid. On distilling to dryness, an acid liquid was obtained, which was neutralised with sodium carbonate. The solution was evaporated to dryness, and the residue distilled with a quantity of sulphuric acid, sufficient to liberate about one-fourth of the acid. The residue in the retort was again distilled with the same quantity of sulphuric acid, and, by repeating this process, the acid was obtained in four fractions. Each of these was converted into the silver salt by boiling with silver carbonate. The silver salts crystallised from the hot saturated solution in small shining needles, which were grouped in stars and feathers. These were dried, first over sulphuric acid, afterwards in the steam-bath, and the silver determined by ignition.

	per cent.
Fraction (1) 0.2350 gave 0.1404 silver=	59.74
" (2) 0.2420 " 0.1450 "	=59.91
" (3) 0.1676 " 0.1002 "	=59.78
" (4) 0.2124 " 0.1264 "	=59.51

Mean.....59.73

Silver propionate contains.....59.67

I also prepared the lead-salt, which exhibited the properties of lead-propionate; it did not crystallise, but dried up to an amorphous gum-like mass. As by oxidation no other acid besides propionic was found, it follows that the alcoholic liquid could only contain normal propyl alcohol. I tried to isolate this body from the remaining liquid, by adding potassium carbonate until it separated into two layers. The upper one was taken off and dried, first over fused potassium carbonate, and afterwards over anhydrous baryta. This liquid, however, proved to be a mixture; it began to boil at 80° C., and the boiling point rose slowly to 96° C. By fractionating, it could be separated into two portions—a smaller one boiling between 80° and 85° , and a larger one boiling above 90° . The portion boiling between 92° and 96° gave, by combustion, numbers agreeing with the composition of propyl alcohol.

0.2238 substance gave 0.4098 carbon dioxide, and 0.2675 water.

	Calculated.	Found.
C_3	36 60.00	59.81
H_8	8 13.33	13.28
O	16 26.67	—
	60 100.00	

I have not yet studied the properties of this alcohol, as I hope to obtain it soon in larger quantities.

The liquid boiling between 80° and 85° appears to be an acetal; it is not acted upon by sodium, and therefore can easily be obtained free from alcohol, by distilling it over this metal. The small quantity was just sufficient for two analyses, the results of which give $C_3H_{12}O_2$ as the probable formula.

(1) 0.2500 gave 0.2725 water, and 0.5280 carbon dioxide.

(2) 0.2755 gave 0.2950 water; the determination of carbon was lost.

	Calculated.	I.	Found.	II.
C_3	60 57.96	57.60	—	—
H_{12}	12 11.53	12.11	11.73	—
O_2	32 30.78	—	—	—
	104 100.00			

How this body has been formed I cannot explain.

As I have already mentioned, chloride of propyl forms only a small fraction of the products obtained by subjecting propane to the action of chlorine, the chief product of the reaction being a liquid which boils at 94° to 98° C., and has the formula C_3H_7Cl .

0.1600 gave 0.3970 silver chloride, and 0.005 silver.

Calculated for $C_3H_7Cl_2$.

Found.

62.8 per cent Cl.

62.4 per cent.

This body is propylene dichloride; for its boiling point not only coincides with that of this compound, but also all its reactions are the same. Heated with potassium acetate, and acetic acid in closed tubes, it is readily decomposed, a high boiling acetate being formed, which, on heating with concentrated potash solution and distilling, yields a liquid, the last portion of which boils between 180° and 190° C., and possesses the sweet taste of propyl glycol. I did not isolate the glycol in the pure state, but proposed to establish its structure by oxidation.

A diluted cold solution of chromic acid acts violently on it, carbon dioxide being evolved in abundance, and a strong odor of aldehyd being recognised, which, on further addition of the oxidising liquid, was changed into that of acetic acid. By distillation, an acid liquid was obtained, which, on boiling with silver carbonate, yielded a silver salt, which crystallised in the well-known needles of silver acetate.

0.3013 of this salt left on ignition 0.1935 silver.

Silver Acetate contains

Found.

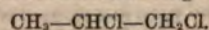
64.67 per cent Ag.

64.22 per cent.

The oxidation products (carbon dioxide and acetic acid) prove sufficiently that the structure of the glycol is expressed by the formula $CH_2-CH(OH)-CH_2(OH)$, which is that of the known propyl glycol.

The foregoing researches establish a general reaction for converting secondary compounds of the alcohols into those of primary radicals. This is effected by replacing the iodine in secondary iodides by hydrogen, and subjecting the hydrocarbons thus obtained to the action of chlorine, by which the primary chlorides are formed.

Of greater interest, perhaps, as possessing an important bearing on the theory of substitution, is the fact that the second substitution product of propane consists of propylene dichloride having the structure



This was the less to be expected, as ethane, C_2H_6 , the hydrocarbon next lower in the series, yields, by acting on it with chlorine as second product, ethylidene

dichloride, $\text{CH}_3\text{—CHCl}_2$. Whilst, therefore, in propane first one hydrogen atom in the methyl group is replaced by chlorine, and afterwards one which is combined with the adjoining carbon atom, in ethane the substitution takes place at one and the same carbon atom. The action of chlorine upon propane is certainly in contradiction to all theories of substitution which have been expounded.

In a second communication I propose to describe the higher chlorinated substitution products of propane.

CONTRIBUTIONS TO THE HISTORY OF EXPLOSIVE AGENTS.*

BY F. A. ABEL, F.R.S., FOR. SEC. C. S.

THE degree of rapidity with which an explosive substance undergoes metamorphosis, as also the nature and results of such change, are, in the greater number of instances, susceptible of several modifications by variation of the circumstances under which the conditions essential to chemical change are fulfilled.

Excellent illustrations of the modes by which such modifications may be brought about are furnished by gun-cotton, which may be made to burn very slowly, almost without flame, to inflame with great rapidity but without development of great explosive force, or to exercise a violent destructive action, according as the mode of applying heat, the circumstances attending such application of heat, and the mechanical condition of the explosive agent, are modified.† The character of explosion and the mechanical force developed, within given periods, by the metamorphosis of explosive mixtures, such as gunpowder, is similarly subject to modifications; and even the most violent explosive compounds known (the mercuric and silver fulminates, and the chloride and iodide of nitrogen) behave in very different ways under the operation of heat or other disturbing influences, according to the circumstances which attend the metamorphosis of the explosive agent (e. g., the position of the source of heat with reference to the mass of the substance to be exploded, or the extent of initial resistance opposed to the escape of the products of explosion).

Some new and striking illustrations have been obtained of the susceptibility to modification in explosive action possessed by these substances.

The product of the action of nitric acid upon glycerine, known as nitroglycerine or glonoine, which bears some resemblance to chloride of nitrogen in its power of sudden explosion, requires the fulfilment of special conditions for the development of its explosive force. Its explosion by the simple application of heat can only be accomplished if the source of heat be applied, for a protracted period, in such a way that chemical decomposition is established in some portion of the mass, and is favoured by the continued application of heat to that part. Under these circumstances, the chemical change proceeds with very rapidly accelerating violence, and the sudden transformation into gaseous products of the heated portion eventually results, a transformation which is instantly communicated throughout the mass of nitroglycerine, so that confinement of the substance is not necessary to develop its full explosive force. This result can be obtained more expeditiously and with greater certainty by exposing the substance to the concussive action of a detonation produced by the ignition

of a small quantity of fulminating powder, closely confined and placed in contact with, or proximity to, the nitroglycerine.

The development of the violent explosive action of nitroglycerine, freely exposed to air, through the agency of a detonation, was regarded until recently as a peculiarity of that substance; it is now demonstrated that gun-cotton and other explosive compounds and mixtures do not necessarily require confinement for the full development of their explosive force, but that this result is attainable (and very readily in some instances, especially in the case of gun-cotton) by means similar to those applied in the case of nitroglycerine.

The manner in which a detonation operates in determining the violent explosion of gun-cotton, nitroglycerine, &c., has been made the subject of careful investigation. It is demonstrated experimentally that the result cannot be ascribed to the direct operation of the heat developed by the chemical changes of the charge of detonating material used as the exploding agent. An experimental comparison of the mechanical force exerted by different explosive compounds, and by the same compound employed in different ways, has shown that the remarkable power possessed by the explosion of small quantities of certain bodies (the mercuric- and silver-fulminates) to accomplish the detonation of gun-cotton, while comparatively very large quantities of other highly explosive agents are incapable of producing that result, is generally accounted for satisfactorily by the difference in the amount of force suddenly brought to bear in the different instances upon some portion of the mass operated upon. Most generally, therefore, the degree of facility with which the detonation of a substance will develop similar change in a neighbouring explosive substance, may be regarded as proportionate to the amount of force developed within the shortest period of time by that detonation, the latter being, in fact, analogous in its operation to that of a blow from a hammer, or of the impact of a projectile.

Several remarkable results of an exceptional character have been obtained, which indicate that the development of explosive force under the circumstances referred to is not always simple, ascribable to the sudden operation of mechanical force. These were especially observed in the course of a comparison of the conditions essential to the detonation of gun-cotton and of nitroglycerine by means of particular explosive agents (chloride of nitrogen, &c.), as well as in an examination into the effects produced upon each other by the detonation of those two substances.

The explanation offered of these exceptional results is to the effect that the vibrations attendant upon a particular explosion, if synchronous with those which would result from the explosion of a neighbouring substance in a state of high chemical tension, will by their tendency to develop those vibrations, either determine the explosion of that substance, or at any rate greatly aid the disturbing effect of mechanical force suddenly applied, while, in the instance of another explosion, which develops vibratory impulses of different character, the mechanical force applied through its agency has to operate with little or no aid; greater force, or a more powerful detonation, being therefore required in the latter instance to accomplish the same result.

Instances of the apparently simultaneous explosion of numerous distinct and even somewhat widely separated masses of explosive substances (such as simultaneous explosions in several distinct buildings at powder-

* Abstract of a paper read before the Royal Society, April 15, 1869.

† *Proceedings of the Royal Society*, vol. xiii., pp. 205 et seq.

mills) do not unfrequently occur, in which the generation of a disruptive impulse by the first or initiative explosion, which is communicated with extreme rapidity to contiguous masses of the same nature, appears much more likely to be the operating cause, than that such simultaneous explosions should be brought about by the direct operation of heat and mechanical force.

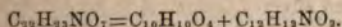
A practical examination has been instituted into the influence which the explosion of gun-cotton, through the agency of a detonation, exercises upon the nature of its metamorphosis, upon the character and effects of its explosion, and upon the uses to which gun-cotton is susceptible of application.

RESEARCHES INTO THE

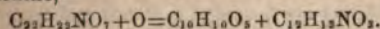
CHEMICAL CONSTITUTION OF NARCOTINE, AND OF ITS PRODUCTS OF DECOMPOSITION.*

BY PROF. A. MATTHIESSEN AND O. R. A. WRIGHT, B.SC.

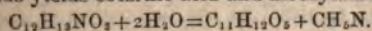
NARCOTINE submitted to the action of water, boiling either in open vessels, or at temperatures above 100° C. in sealed tubes, splits up into meconin and cotarnine,—



Narcotine heated *per se* to about 208° splits up in the same manner, but the cotarnine is at that high temperature immediately decomposed. On heating hydrochlorate of narcotine with ferric chloride, the latter is reduced, and the narcotine converted into opianic acid and cotarnine,—

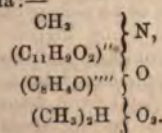


When narcotine is heated with excess of hydrochloric acid for a short time (about two hours), chloride of methyl is formed, and one atom of H substituted for CH₃ in the narcotine. If heated for some days two atoms of H are substituted for two of CH₃. When heated with fuming hydriodic acid, iodide of methyl is formed in such quantities as to prove that three atoms of H are substituted for three of CH₃. Cotarnine has for its formula C₁₂H₁₂NO₃, and is capable of crystallising with half a molecule, and with a whole molecule of water of crystallisation. Cotarnine heated with dilute nitric acids yields cotarnic acid and methylamine,—



When cotarnine is heated with strong hydrochloric acid, chloride of methyl is formed, and hydrochlorate of cotarnamic acid.

Opianic acid, under the influence of nascent hydrogen, is reduced to meconin; the same acid, heated with bichromate of potash and dilute sulphuric acid, becomes oxidised to hemipinic acid. Opianic acid, heated with caustic potash, splits up into meconin and hemipinic acid. This latter acid is capable of crystallising with different amounts of water of crystallisation, crystals with half a molecule, with a whole molecule, and with two molecules of water having been obtained. All the reactions of narcotine and its products of decomposition may be satisfactorily accounted for by the following rational formula:—



* Abstract of a paper sent to the Royal Society, Feb. 18th, 1869.

ON A NEW METHOD OF MANUFACTURING AND REFINING SUGAR.

BY M. F. MARGUERITTE.

It is well known that the present method of manufacturing sugar, notwithstanding the improvements which it has received of late years, does not nearly allow of the extraction of the whole of the sugar contained in the beetroot, and that the residue contains about 50 per cent of its weight of the substance to be obtained. The combinations of baryta and lime with sugar, observed by M. Peligot, and the discovery of osmose and dialysis by Messrs. Graham and Dutrochet, have given rise to many attempts to extract from molasses the sugar which it contains in a non-crystallisable form. Some of the elements contained in molasses are already known; by examining the products of its incineration, the exact nature of the bases has been determined, and the existence of potash, lime, and soda, well established; but with regard to acids, colouring and extractive matters, little is known. The two most common methods of obtaining the organic acids are as follows:—First, to precipitate the organic salts by neutral or tribasic acetate of lead, and then to decompose the salts of lead with sulphuretted hydrogen to liberate the acid. Secondly, to treat the salts of potash with a mixture of alcohol and sulphuric acid, which forms sulphate of potash, and dissolves the displaced organic acid. The latter method, which was the one employed by us, has been pointed out by Messrs. Liebig, Gmelin, and Zeise,* for the preparation of various acids. It is simple, always efficacious, and allows of the production of the substance to be obtained without alteration, which is not always the case in the decomposition of organic salts of lead by sulphuretted hydrogen. We therefore treated some molasses with a mixture of excess of alcohol with sulphuric acid. After sufficient stirring, the molasses yielded on the one hand a considerable precipitate, and on the other a highly coloured liquid. There were discovered—

In the Solution.	In the Precipitate.
Metapectic acid	Sugar
Parapectic "	Metapectine
Lactic "	Parapectine
Malic "	Apogluic acid
Burnt bitter principle	Sulphates of potash,
Mannite	soda, and lime†
Sundry colouring matters	

It may be seen that the alcoholic liquid, while retaining certain elements of the molasses, precipitates several products which remain mixed with the sugar and render it impure; whence it follows that this method of analysis cannot be industrially employed for extracting and purifying sugar. Nevertheless, a mixture of alcohol and different acids has more than once been proposed for the treatment of saccharine matter, and a system founded on the employment and reactions of the substances just mentioned has long since been tried, and unsuccessfully, for bleaching and purifying crude sugars.† Our previous remarks will sufficiently explain why such a method could not succeed. Our mode of conducting the process is altogether different. Instead of precipitating the sugar by an excess of concentrated alcohol, it was suspended in solution by the use of alco-

* *Annales de Poggendorf*, 1822-1825.

† Messrs. Fischman and Mendès, who have been for some time pursuing this study in my laboratory, will soon, I hope, publish the result of their researches.

‡ M. Paulet, 1837, 1838.

hol relatively diluted (85). Thus it was possible to filter the liquor and remove the sulphates, and most of the insoluble substances. A second volume of alcohol at 95° was then added to concentrate the medium and determine the crystallisation of the sugar. Under these conditions the mean strength of the alcohol is such that the sugar ought to crystallise immediately; however, it only settles very slowly. This temporary inertia of the sugar gives time enough to eliminate in a complete and definite manner all foreign substances, so that the sugar is finally obtained extremely pure. The alcoholic liquid, which thus contains more sugar than it can normally dissolve, assumes the condition of supersaturation.

This is a well-known phenomenon, especially since the labours of M. Gernez, and constantly occurs in saline and saccharine solutions. The condition of supersaturation being once established, it is then easy to effect a rapid crystallisation of the sugar by the addition of that substance itself in either crystals or powder. In fact, the addition of pulverised sugar to the alcoholic liquid induces, in a very short time, the total precipitation of all the sugar it contains, in the same way as the presence of crystals in syrups from manufactories and refineries, develops crystallisation; though in a much slower manner.

The alcoholimetric degree of the solution rises, the volume of added sugar increases, and in less than five hours the crystallisation is complete, whilst, in the absence of foreign crystals, it would not have terminated in eight days, or even longer. The mode of operation is as follows:—Mix, by agitation, 1 kilogramme of molasses, marking 47° Baumé in the cold, with 1 litre of alcohol at 85°, acidulated with 5 per cent of monohydrated sulphuric acid. The liquid thus obtained is filtered, and receives the addition of 1 litre of alcohol at 95 degrees; it will then furnish, upon contact with 500 grammes of powdered sugar, an excess of 350 grammes of pure sugar,* say 35 per cent of the weight of the molasses, or 70 per cent of the sugar which it contains (50 per cent). The composition of the product, after being bleached with its own volume of alcohol at 95 degrees, and then dried, is as follows:—

Crystallisable sugar	99.50
Ash	0.05
Glucose	inappreciable traces.

Such is the operation, whose industrial progress and success are based on a purely scientific observation, which is here applied in a very interesting manner. About 10,000 kilogrammes of saccharine matter (molasses, third of the manufactory, last of the refineries) were treated in this manner, and gave considerable augmentations upon the normal yield, these being of course always in proportion to the actual quantity of molasses containing the product treated.

For the practical trial of this process recourse was had to the kindness of one of our friends, M. de Sourdeval, who was good enough to place at our disposal his works at Laverdines, and to aid us with his advice.

Finally, this process is applicable to all saccharine matters without exception, and presents the following advantages:—

1. The extraction of from 35 to 38 kilogrammes of sugar from 100 kilogrammes of molasses, that is, an increase upon the total yield of from 24 to 26 per 100.
2. The sugar is obtained directly and immediately,

* By adding to the alcoholic liquid 0.006 of chloride of calcium or barium, to precipitate the last traces of the sulphates which remain dissolved, the sugar will be rendered free from sulphates and chlorides.

without the dissolvings, bakings, and loss, inherent to the ordinary process.

3. An almost entire suppression of bone-black in manufactories and refineries.—*Comptes Rendus.*

FURTHER RESEARCHES ON JARGONIUM, AND THE CEYLON JARGON.

BY H. C. SORBY, F.R.S., &C.

IN my last note I told you that I had found in zircons what appeared to be another elementary substance. I have, since then, made many experiments, and find that the facts are really far more interesting than if they were the effect of a new element. Judging from analogy with all other known substances, no other conclusion could have been formed; but I now find that jargonium exists in two distinct conditions, which have different specific gravities and optical properties. The flamed borax beads give two entirely different spectra, according to the temperature to which the enclosed crystals have been exposed; and there is an analogous difference in the silicates. On taking a pale green jargon, which, naturally, showed a mere faint trace of the absorption bands, and keeping it at a bright red heat for some time, the specific gravity gradually increased from 4.20 to 4.52, and the spectrum then showed all the narrow black absorption bands in as great perfection as my best specimen. This fact is, of course, very interesting; since we can now artificially alter jargons so as to show the bands in the same splendid manner as a few do naturally, and shall thus be able to obtain them without much difficulty, to use as a most excellent natural standard scale, to measure the position of the absorption bands in other spectra.

Broomfield, Sheffield, April 24th, 1869.

ON A NEW ARRANGEMENT OF BINOCULAR SPECTRUM MICROSCOPE.*

BY WILLIAM CROOKES, F.R.S., &C.

THIS instrument has been devised to obviate the disadvantages of the ordinary spectrum microscope. The principal features of the new apparatus are the sub-stage and the box of prisms. The former carries a sliding plate to hold the slit and apertures, a spring stop and screws for adjusting them, and a reversed object glass. The slit and this object glass are about two inches apart, and if reflected light is passed along the axis of the instrument, the object glass forms a very small image of the slit in front of it. A milled head moves the whole sub-stage, and screws bring the image of the slit to any part of the field. Beneath the slit is an arrangement for holding an object of irregular surface or dense substance. The stage has a concentric movement, so as to permit the object to rotate and enable the image of the slit to pass through it in any direction.

The direct vision prisms consist of three flint and two crown, fitted in a box screwed into the end of the microscope. By means of a pin they are thrown in or out of action. The object glass screws on in front of the prism box.

By taking the illumination from the sky or a white cloud, Fraunhofer's lines are visible, and by direct sunlight they are seen in great perfection; the dispersion is sufficient to cause the spectrum to cover the whole

* Abstract of a paper sent to the Royal Society, April 23d, 1869.

field, and the achromatism of the lenses being nearly perfect, the lines from *b* to *c* are practically in the same focus.

A double image prism near the slit enables two spectra to be seen, oppositely polarised, and the variations in the absorption lines are at once visible. A Nicol's prism as polariser, and another as analyser, can be connected, and these enable the brilliant colours shown by some crystalline bodies when seen by polarised light, to be examined.

If a substance is dark coloured, or the illumination not brilliant, the whole of the light should be passed up the tube to one eye; but when the light is good, the appearance of the spectrum, and the power of grasping faint lines, are greatly improved by dividing the light with a Wenhams prism, and using both eyes; whilst the stereoscopic effect thereby communicated to some absorption and interference spectra, throws a new light on the phenomena.

By using a spirit lamp instead of the illuminating lamp, the instrument answers admirably for examining flame spectra. The characteristic yellow, crimson, or green lines are seen beautifully sharp, on introducing sodium, lithium, or thallium into the flame.

ON SOME OPTICAL PHENOMENA OF OPALS.*

BY WILLIAM CROOKES, F.R.S., &C.

By means of the above-described spectrum microscope some curious optical phenomena of opals have been observed.

If an opal which emits a fine broad crimson light is held in front of the slit of a spectroscop, or spectrum microscope, at the proper angle, the light is generally seen to be purely homogeneous, and all that is visible is a brilliant luminous line, varying somewhat in width, and more or less irregular in outline, but very sharp, and shining brightly on a perfectly black ground. If the source of light is now moved so as to shine into the spectrum apparatus through the opal, the above appearance is reversed, and we have a luminous spectrum with a jet-black absorption band in the red, identical in position, form of outline, and sharpness, with the luminous line previously observed.

From these and other experiments it has been found that those parts of the opal which emit red, yellow, green, or blue light are opaque to light of the same refrangibility which they emit. This is, doubtless, a general law, following, of necessity, the mode of production of the flashes of colour.

From the descriptions of the absorption phenomena of a series of opals, the following are selected as the most striking:—

No. 1 shows a single black band in the red. When properly in focus this has a spiral structure. Examined with both eyes it appears in decided relief, and the arrangement of light and shade is such as to produce a resemblance to a twisted column.

No. 2 gives an irregular line in the orange. Viewed binocularly, this exhibits the spiral structure in a marked manner, the different depths and distances standing well out; upon turning the milled head of the stage adjustment, so as to carry the opal slowly from left to right, the line is seen to revolve and roll over, altering its shape and its position in the spectrum. It is not easy to retain the conviction that one is looking merely at an

absorption band in the spectrum, and not at a solid body possessing dimensions, and in actual motion.

No. 9 shows a very sharp and black band, stretching diagonally across the green, touching the blue at the top, and the yellow at the bottom.

No. 12 gives a narrow, straight, and sharply cut line in the green; this might easily be mistaken for an absorption band caused by an unknown chemical element.

Other opals show an absorption band travelling along the spectrum, almost from one end to the other, as the opal is moved sideways. All these black bands can be reversed, and changed into luminous bands, by examining the opal with reflected light.

NOTE ON

THE DISCOVERY OF THE WEIGHT OF THE AIR.

BY G. F. RODWELL, F.C.S.

In the last number of this journal, M. l'Abbé Hamy has replied at some length, and with much ingenuity, to certain statements, by which I endeavoured to prove that Aristotle did not discover the weight of air by direct weighing; and I am bound to confess that his further discussion of the subject has not caused me to alter my opinion, the grounds for retaining which will be best indicated by considering the nature of the objections. It is with regret that I differ from M. Hamy, for he has preserved throughout a courteous spirit too rarely to be met with in controversies, and I will here beg him to discover no discourtesy in the following remarks, which are not made in a contentious spirit, or in forgetfulness of his much learning.

M. Hamy commences his animadversions by giving the Greek, Latin, French, and English texts of the disputed passage, in order to show that the word usually rendered *bladder* should be in reality *leather bag* or *bottle*; this I am quite willing to cede: *ἀσξός* (perfectly rendered in the Latin translation by *utrem*, and in the French translation by *outre*) rightly signifies a wine-skin or leather bottle, literally *the skin of an animal*; such skins were not alone used for containing liquids, but were sometimes inflated with air and employed by swimmers and by fishermen: in the British Museum there is a representation, on one of the sculptured blocks of Ancient Assyria, of a fisherman supported in mid stream by an inflated skin. Seeing that the word is *ἀσξός*, it is strange that it should so invariably, both by ancient and modern commentators, be rendered *bladder*, and that Ptolemy the mathematician, and Simplicius, should have repeated the experiment with a bladder; it is to be borne in mind, however, that the latter would always be easier to procure and more convenient for the experiment than a wine-skin, both on account of its greater flaccidity, and because it could be more easily closed air-tight: Mr. G. H. Lewes, an exact and profound scholar, writes as follows, in a discussion of the treatise *Περί οὐρανοῦ*, in, I suppose, the most exhaustive modern work on the scientific knowledge of Aristotle*:—"In other words, everything except fire in its own place, has weight. That even air has weight is proved by the fact that a bladder filled with air is heavier than the same bladder empty."

The main point of M. Hamy's former communication was to show that Aristotle employed, "*not an extensible bladder, but an almost inextensible leathern jar, successively full and empty of air.*" He now says—

* Aristotle: a Chapter from the History of Science, including Analyses of Aristotle's Scientific Writings, chap. 7, p. 142.

* Abstract of a paper sent to the Royal Society, April 23rd, 1869.

"Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air." Now I say this is an argument in a circle, if ever there was one; it is a sophistry essentially mediæval; a modus of reasoning which reminds me somewhat of the argument of the brazen seal concerning matter and form, in the *Introductio ad Theologiam* of Peter Abelard; in character it appertains more to the theologian than to the man of science; it savours of the Sorbonne rather than of the Lycée Napoleon. "And though," says Master Peter, concerning the brazen seal, "they are essentially the same thing, yet the brazen seal is made of the brass, not the brass of the brazen seal, and the brass is the matter of the brazen seal, not the seal of the brass," and so on interminably with excessive ingenuity and subtlety. No wonder Abelard was the most brilliant disputant and dialectician of his age; who could answer such an argument off-hand in a public debate, and who could answer off-hand the argument given above about resistance to extension, and the marvellous corollary? This must surely be an example of one of the "useless and illegitimate" moods of the syllogism of which Aristotle writes. Again, if "almost inextensible," how can the leathern bottle be said to be "open and extensible?" The fact is, M. Hamy has shifted his ground, and the former arguments rise up and destroy the latter, as the armed men which sprang from the teeth of the dragon slew each other when Jason threw a stone into their midst. I certainly cannot admit that *πεφυσσημένος ἀέρας** means either "an almost inextensible leathern jar, or a leathern bottle which, without being rigid, is very slightly extensible." *Πεφυσσημένος* (*φυσάω*) clearly signifies *blown out, or inflated*, and there is no idea of partial inextensibility in the whole phrase, neither would Aristotle have spoken of a leathern bottle full of air (that is, already inflated), as *κενός*, and of the same bottle as *πεφυσσημένος* when air was compressed into it. This is a mere perversion of terms. Whether the receptacle employed were a bladder or a leathern bottle, it was capable of existing in a state of collapse (*κενός*) and in a state of inflation (*πεφυσσημένος*), and the basis of the experiment described was the causing the receptacle to pass from the former to the latter state, in all probability as Simplicius asserts, by forcing air into it from the lungs.

In M. Hamy's former communication (p. 119 of this volume (*Am. Repr.*, May, 1869, page 263) he says, "For myself, I believe that the great philosopher, by means of a blowpipe, confined in his leathern jar more air than it would contain at the normal pressure." He now entirely deserts this position, and calls up a *Deus ex machinâ* to account for the filling of the vessel. "Mr. Rodwell," he says, "reasons, in the persuasion which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath." I "reasoned in this persuasion" both because M. Hamy, whose argument I was answering, so reasoned, and further, because one of the most profound and exact of the older commentators of Aristotle likewise gives it as his persuasion. Then comes the *Deus ex machinâ*. "But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek

smiths were acquainted with the use of bellows." I may add that long before the time of Homer, the Egyptians were acquainted with bellows; and it is believed that they introduced a valve at least as early as the time of Moses*; and further, as I have elsewhere endeavoured to show,† that bellows were probably invented by the makers of these leathern bottles of which we are speaking. Then as to the question of the balance, if we admit, with M. Hamy, that the ancient Greeks possessed balances capable of weighing minute quantities of gold (of which I believe we have no proof), it would be impossible that a wine skin capable of holding fifteen litres (the size which he assumes), could be weighed by such a balance, neither could compressed air be retained in a vessel of this nature.

Next as to those who repeated the experiment and failed, M. Hamy says, "Ptolemy and Simplicius denied Aristotle's assertion because they did not admit the theoretical explanation of the philosopher;" on the contrary, they were well versed in the writings of Aristotle, and they repeated the experiment with every hope of success. The fact that Averroës (or Ibn-Roschd, as M. Renan‡ prefers to call him) "affirms that he succeeded," I think of but little value, and for the following reasons:—When the Sultan Yakoub-Josouf requested Ibn-Roschd to compose a commentary on the works of Aristotle, he was probably unaware that he did not understand Greek; the fact being that Ibn-Roschd studied Aristotle through Arabic or Syriac translations, which, in their turn, were made from a Latin translation;§ and yet this man was called "*L'ame d'Aristote*," and it was mainly through him, assisted by the University of Cordova, that the Peripatetic dogmas were disseminated, and that the stupendous mass of false philosophy and perverted Aristotelianism, called Scholasticism, arose to fetter the intellect of Europe. Surely Simplicius and Ptolemy ought to be heard before a man who received his knowledge of Aristotle not even at second-hand. At this time, Heloise was one of the very few Greek scholars in Europe. With all respect for the University of Cordova, then the most famous and learned university in Europe, I do not think that the critical knowledge of Greek possessed by it as a whole would have satisfied a Regius Professor of our day.

M. Hamy speaks of Aristotle as "the most exalted genius that human reason, left to its own powers, has produced." While admitting that he was one of the most exalted geniuses which the world has produced, I cannot say that his intellect was "left to its own powers." He was sufficiently wealthy to procure a good library at a time when books were extravagantly expensive, and to these he applied himself so well that he received the name of "the Reader." He was seven years at the court of Macedon, and Alexander the Great, first his pupil, remained his friend, and did all

* "Manners and Customs of the Ancient Egyptians," by Sir G. Wilkinson.

† CHEMICAL NEWS for September, 1863 (*Eng. Ed.*).

‡ See his admirable "*Averroës et Averroïsme*;" also Figuler's "*Vies des Savants du Moyen Âge*." There is a large collection of MSS. attributed to Ibn-Roschd in the library of El Escorial. Averroës is a Spanish form of the Arabic Ibn-Roschd; it was sometimes spelt Averroës or Adverroës; his full Arabic name was Aboulwalid-Mohammed-Ibn-Ahmed-Ibn-Mohammed-Ibn-Roschd. He was born in Cordova, in 1126; died 1198.

§ Mr. Lewes has stated the case forcibly in the following sentence:—"The barbarous jargon which the European Schools had to master, when they opened Latin versions of Averroës, may be imagined when it is known that these were Latin translations from a Hebrew version of an Arabic commentary on an Arabic translation of a Syriac version of a Greek text;" that is the original text of Aristotle.—*History of Philosophy*, vol. II., p. 66.

that was possible to further his literary labours; but, above all, for no less than seventeen years Aristotle enjoyed the instruction and the friendship of Plato, the greatest and divinest of Greeks, "the finest of human intellects, exercising boundless dominion over the finest of human languages." No; if ever there was a man who possessed every possible intellectual advantage which his age could furnish, that man was Aristotle.

Having now considered M. Hamy's arguments, little remains to be said. The sentence which has furnished us with this discussion is sufficiently brief:—*Ἐν τῇ αὐτοῦ γὰρ χώρα πάντα βάρος ἔχει πλὴν πυρὸς, καὶ ὁ ἀὴρ. Σημαίνει δ' ὅτι ἔχει πλεονὸν ὁ περυσσόμενος ἀέρας τοῦ κενοῦ.* Looking at it either in its most literal or most paraphrastic form, analysing it, confronting it with collateral evidence, surrounding it with sophistries, applying to it the subtlest forms of argumentation, I yet see not that we can deduce from it the fact that Aristotle discovered the weight of air. Whether he used his own lungs or a pair of bellows to inflate his receptacle, matters little; whether that receptacle were a bladder or a leather bottle matters less, but it must needs be shown that the receptacle could contain within it compressed air in sufficient quantity to show a difference of weight when it was weighed in air; that it could be closed securely while containing compressed air; and that no leakage could ensue; finally, that there were balances capable of weighing such bulky things, and at the same time of indicating the slight difference of weight possible under the circumstances. Till this can be demonstrated we must still admit that Galileo made the first accurate and conclusive experiments to demonstrate by direct weighing that the air has weight. It is surprising to find Aristotle designated a good experimentalist; he was indeed an ardent inquirer and a careful observer, but he seldom attempted to examine material facts by a suitable methodical instrument; he lacked even the rudiments of an experimental method; he was insufficiently critical in regard to physical matters. But he was so infinitely great in many respects that, if he had been a great experimentalist, the world would not have regarded him as a greater man. Discoveries are rarely born out of due time; when the world is ready for them and the *modus* of its thought capable of assimilating them, then they appear; if they appear out of due course, and fall upon an uncongenial age they die out and are lost. Facts—whether they be social, political, metaphysical, or physical—belong to ages of development, characterised by the conditions of peoples, of civilization, of mental calibre, and of intellectual activity; and the intellectual activity of an age breaking as a wave upon the shores of humanity, leaves a residue which gradually accumulates, and forms a resting place upon which more advanced phases of thought repose.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1869.

(Continued from Am. Repr., May, 1869, page 255.)

DR. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

MR. E. T. CHAPMAN read an abstract of a paper by himself and Mr. Miles H. Smith "On the Butylic Compounds derived from Alcohol by Fermentation." The authors had operated on about 17 gallons of London fusel oil. After subjecting it to a series of fractional distillations, they obtained about five litres of a body boiling within some 3-10ths of a degree; this

body consisted of butylic alcohol, contaminated with small quantities of iso-butylic alcohol. The distilling vessel consisted of a tin can of two gallons capacity; its neck was closed by a cork, through which passed a wide glass tube, bent twice at an obtuse angle. From this butylic alcohol, the authors prepared the iodide, bromide, nitrate, acetate, and nitrite of butyl, from which the iso-butyl compounds are separated by fractional distillation.

Iodide of Butyl is a clear, colourless, mobile liquid, boiling constantly at 121°. Its specific gravity is—at 0°, 1.6301; at 16°, 1.6032; at 50°, 1.54816. Ten thousand volumes at 0° become, at 16°, 10,168; and at 50°, 10,529. Instead of heating the crude butylic alcohol with iodine and phosphorus, the authors prepare it by boiling the crude alcohol with four times its volume of hydriodic acid of specific gravity about 1.8. The iodide which separates from the acid is run into a flask containing carbonate of soda and water. The mixture is distilled, and the colourless iodide separated and dried with chloride of calcium and fractionally distilled. It possesses in a high degree the property of splitting up into hydriodic acid and olefine.

Bromide of Butyl is best obtained by saturating the alcohol with gaseous hydrobromic acid. The saturated solution is mixed with its own volume of aqueous hydrobromic acid (sp. gr. 1.6); it is then gradually heated in closed vessels to the boiling point. When the oily layer ceases to increase, the bromide is separated from the acid and distilled with a dilute solution of carbonate of soda; the oily liquid is then separated from the water, dried over chloride of calcium, and fractionally distilled. Its specific gravity is 1.2702 at 16°.

Nitrate of Butyl boils at 123°. Its specific gravity is 1.020 at 16°, and it closely resembles nitrate of amyl. To prepare it, 100 c.c. of a mixture consisting of two volumes of sulphuric acid and one of nitric acid (sp. gr. 1.4) are placed in a beaker standing in cold water and ice. About 30 c.c. of the alcohol are slowly conveyed by means of a tube beneath the surface of the acids, which must be constantly stirred: the nitrate which rises to the surface is decanted into a retort and distilled; it is then separated from the water and dried with chloride of calcium, and if the alcohol was not pure it must be fractionally distilled.

Nitrite of Butyl is a yellow mobile liquid, boiling at about 67°. It is obtained by slowly passing nitrous acid into butylic alcohol, which is kept cool with water. When saturated, the nitrite is washed with water, with dilute caustic potash, and again with water; it is then dried over chloride of calcium and fractionally distilled. Its specific gravity is at 0°, 0.89445; at 16°, 0.8771; and at 50°, 0.82568; therefore 10,000 volumes at 0°, become 10,198 at 16°, and 10,833 at 50°. One hundred parts of butylic alcohol may be made to yield from 105 to 110 of the nitrite.

Acetate of Butyl is prepared by mixing crude butylic alcohol with glacial acetic acid, saturating with HCl, warming in the water bath, and washing with cold water. The washings are distilled, the distillate treated with carbonate of potash, the oily layer separated and treated again with glacial acetic and hydrochloric acids, and then washed. The acetate is now carefully dried; first by agitation with carbonate of potash, and then by long standing over a new portion of the freshly ignited carbonate; it is then fractionally distilled. Acetate of butyl boils at 117.5; its specific gravity is 0.89006 at 0°, 0.8747 at 16°, and 0.83143 at 50°. Ten thousand volumes at 0° become 10,186 at 16°, and 10,716 at 50°.

Butylic Alcohol.—The authors obtained this most readily by pouring the pure acetate upon about half its weight of caustic soda. After awhile, the mixture boils violently, when it is cooled by immersing the vessel in cold water; water is now added, and the whole distilled. The distillate consists of butylic alcohol, acetate of butyl, and water; it is now saturated with carbonate of potash, the oily portion decanted, and again treated with caustic soda. The mixture is now treated with water and again distilled, the distillate treated as before with carbonate of potash, then thoroughly dried by boiling with and allowing it to cool over carbonate of potash.

It must then stand over a large quantity of caustic lime for some weeks, or be digested with it for twelve or fourteen hours, at a temperature between 65° and 75° . On distilling it off the lime, it is perfectly dry; it boils at $108\frac{1}{2}$ at the normal pressure, going quite to dryness below 109° . It was found that it could not be dried with sodium.

Mercury Butyl is easily prepared by the general method given by Frankland and Duppa for the preparation of the mercury compounds of the alcohol radicals. Five grammes of sodium are dissolved in 2,000 grammes of mercury, and agitated with an equivalent quantity of iodide of butyl, to which 1-10th of its weight of acetic ether has been added. The mixture is well shaken; great heat is given out during the reaction. When the bottle is nearly cold, the remaining mercury is poured out in a clean state, and again treated with iodide of butyl and acetic ether. This process is continued till a sufficient quantity of crude mercury butyl is obtained: it is then subjected to distillation. The distillate consists of two layers, the lower of which is mercury butyl, contaminated with iodide of butyl and acetic ether; these are separated by driving a current of steam through it, until no iodine can be detected. The water is then separated, and the compound dried with chloride of calcium. So prepared, mercury butyl is a colourless, transparent liquid of specific gravity 1.7192 at 16° . It cannot be distilled by itself; but it will stand a temperature of 130° without much decomposition.

The authors state that the butyl spoken of throughout the paper, is iso-propyl-methyl; and the alcohol in Kolbe's nomenclature, iso-propyl carbinol; and that the alcohol yields on oxidation iso-butylic acid. The authors base their assertion that they are dealing with butyl compounds on a combustion of the alcohol. Burnt with chromate of lead, 0.3507 gramme of the alcohol yielded 0.8348 gramme of carbonic acid, and 0.440 gramme of water, the following percentages of carbon and hydrogen are calculated:—

			Theory.
C ₄	....	64.92	 64.87
H ₁₀	....	13.94	 13.51
O	....	—	.... 21.62

A combustion of the iodide obtained from the alcohol was also made. Burnt with chromate of lead and copper turnings, 0.844 gramme of the iodide yielded 0.807 gramme of carbonic acid, and 0.3775 of water. Three iodine determinations were made on three different samples of the iodide prepared at different times: 1.257 grammes yielded 1.6016 of iodide of silver; 0.6904 gramme yielded 0.8839; and 0.8830 of iodide yielded 1.1253 of silver. The following are the percentages calculated:—

			Theory.
C ₄	.....	26.08	 26.09
H ₉	.....	4.97	 4.89
I	.....	68.97	(mean) 69.02
		100.02	100.00

The iodide was also titrated in the manner described by Professor Wanklyn, the digestion being carried on in sealed tubes.

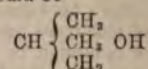
The atomic weights of propyl, butyl, and amyl being C₃H₇=43, C₄H₉=57, C₅H₁₁=71, the authors conclude that a determination of the atomic weight at once points out with which radical they are dealing.

The atomic weights, as deduced from the iodine determinations, are—(I.) 57.43; (II.) 56.55; (III.) 57.4. The atomic weights deduced from the titrations are—(I.) 56.05; (II.) 56.76.

The PRESIDENT said that Mr. Chapman had evidently arrived at some very interesting results, and there were many gentlemen present who were familiar with the investigations made in the same line by Würtz and Butlerow. It was very essential to distinguish between the primary, secondary, and tertiary alcohols, and a discussion of the various points brought forward might eliminate some of the discrepancies which appeared to exist in the physical properties of the sub-

stances described by Mr. Chapman and his predecessors. There was evidently some difference as to boiling points and specific gravities, and they were not quite sure they were speaking absolutely of the same substances.

Dr. ODLING corroborated the President's remarks as to the importance of forming a classification of alcohols, and to obtain reactions, by which the class to which an alcohol belonged might be readily identified. He rather objected to some of the definitions occasionally given of alcohols and other bodies in text-books. The definition should be that it is a body which behaves in a particular manner, from which its composition is afterwards inferred. An alcohol which, when oxidised, yields an acid belonging to the ordinary fatty series, is classed as a primary alcohol on that ground; and that is a reaction, or a kind of fact, upon which a definition may be directly based. With regard to classification, he preferred to represent the alcohol on the hydrocarbon from which it was derived as containing the one residue CH₃, and associated with that the residue CH₂ taken three times, CH(CH₂)₃. The residue CH₂ undergoes that modification in which the hydrocarbon is changed into the alcohol, so that if represented fully it would be



They were acquainted with alcohols in which the residue CH₂ occurs twice and three times, and perhaps only once. If CH₂ was replaced by peroxide of hydrogen, he should consider it a primary alcohol. When one of the H's was replaced by OH, he considered it a secondary alcohol, and the final H being replaced by OH would make it a tertiary alcohol. Mr. Chapman called his alcohol a primary alcohol, because CH was replaced by peroxide of hydrogen, therefore there would be three different classes of primary alcohols, one which contained one, another with two, and a third with three CH.

Professor WANKLYN preferred to classify according to the linking, and to have criteria by which to recognise the linking. The criterion by which a primary alcohol was recognised was, that by oxidation, it gave an acid containing the same number of atoms of carbon as the alcohol itself. By oxidation, the alcohol Mr. Chapman had obtained gave isobutylic acid, which has the same number of atoms of carbon as the alcohol. This alcohol would be called a pseudo-primary, or an iso-primary alcohol; the proof that it was not the normal butylic alcohol was that the acid formed was not the common butylic acid, but the isobutylic.

Dr. ODLING: What is the proof that the common butylic acid is not the isobutylic, and this the common?

Professor WANKLYN said the proof was two or three years old. Butylic ether, boiled at 119° , isobutylic at 112° . The lime salt of one was more soluble than that of the other.

Dr. ODLING thought Mr. Wanklyn did not understand his question. He asked for the proof that the particular formula applied to the acid Mr. Chapman had obtained, and not to the ordinary.

Mr. WANKLYN said there was a difference in the reaction, and therefore a different formula must be written to express it.

Dr. ODLING would not for a moment be understood to doubt the correctness of the formula, but Mr. Wanklyn had not taken the point of his question. There were two distinct butylic acids, and two distinct butylic alcohols, in addition to a great many more; how did Mr. Wanklyn know that the formula *a* applied to the compound *a*, and not to the compound *b*, and *vice versa*?

Mr. WANKLYN replied that, in addition to the different reactions, there was the synthetical proof. Isobutylic acid might be made from cyanide of isopropyl, and the synthetical proof of the composition of isopropyl gave synthetical proof of the composition of isobutylic acid.

Mr. CHAPMAN said there was also the analytical proof. Isobutylic acid would break up in oxidation, while the normal did not. He did not quite agree with Dr. Odling's

proposed formulæ. If they had only primary, secondary, and tertiary alcohols to deal with, they only wanted criteria to distinguish those three, and his method of viewing them had the advantage of presenting at one view what was the possible number.

Dr. ODLING observed that, with regard to formulæ, it was a mere matter of preference and convenience which was adopted. As to the other point, Mr. Wanklyn misunderstood his expression. It was not the classification he objected to, but the definition. As a matter of logic, the definition should have reference to the criterion as nearly as possible, so that, in saying whether this body belonged to the *a* or the *b* class, the great thing was to see whether it behaved in a particular way.

Dr. CRUM BROWN felt very strongly the importance of classifying substances and ideas rather according to facts than the particular way in which one might choose to represent the facts. An alcohol was a body which had certain reactions when treated with acids; some yielded by a particular process an aldehyd; some, by oxidation, yielded an acid; then let them be classified by the way in which they yielded these. Let there be a functional classification of alcohols as well as of aldehydes and acids, and then they would get an inverse operation to represent the different classes of alcohols, and get rid of the danger which attended the free use of the atomicity theory. This theory did not seem to be in harmony with the general dynamical principles of science, and therefore it must be replaced by a theory which would have a true place in physics.

Mr. WANKLYN desired to say that in order to classify, it was necessary to co-ordinate the facts. They could only make out what were the relative values of the facts by the theory, and to proceed rationally they must classify from theory, and not from facts.

Dr. GUTHRIE wished to ask Mr. Chapman what was the precise origin of the fusel oil, upon which he had worked. One of the earliest instances of isomerism, viz., the two amyl alcohols, was discovered by Pasteur in working with fusel oil; and therefore Mr. Chapman should have mentioned the precise origin of this fusel oil, whether from potato or grain spirit.

Mr. CHAPMAN was very sorry that he could not answer that question. Distillers were not given to impart information. In many distilleries mixed grains were employed, and therefore it would be difficult to answer Dr. Guthrie's question. The alcohol and the fusel oil were mixed before he had it, so he could not answer with any certainty what the matter was. He had, however, examined many other specimens of fusel oil, and they all gave symptoms of containing butylic alcohol. If it was found that on treating normal iodide with alcoholic potash no butyl compound was evolved, and that on treating the isopropyl carbinol with alcoholic potash, butylene was evolved, they would have fair ground for making a wide division of the alcohols, and perhaps be justified in calling them hydrates of olefines and alcohols. He wished that the Society would use its influence to obtain a careful arrangement of the already known chemical data.

The PRESIDENT, in thanking Mr. Chapman for his paper, said that he could not see there would be any good result in promoting the experiments he had proposed. If there was anything treacherous as a basis on which to found an idea of the purity of compounds, it was the boiling point and specific gravity. Seven years' experience of his own, which was followed up by Dr. Miller, had led him to the conclusion that they could not place the slightest reliance on them.

Anniversary Meeting, Tuesday, March 30th, 1869.

Dr. WARREN DE LA RUE, F.R.S., *President, in the Chair.*

THE business of the evening commenced with the reading of the financial statement by the Treasurer, which had been audited by Mr. Tuson and Mr. Robert Warrington.

The PRESIDENT called the attention of the Society to a circular from Yale College, warning the scientific public against an impostor who was ostensibly collecting minerals and was receiving moneys in the name of some of the principals of the college. He then proceeded to read the address, which gave a very clear account of the year's progress in chemistry, and referred to some of the leading investigations in the various departments of chemical science.

Mr. HEISCH, in proposing a vote of thanks to the President for his address, spoke in laudatory terms of the way in which Dr. De La Rue had filled the Presidential chair, and proposed that the address be printed, and circulated amongst the fellows of the society.

Professor WANKLYN seconded the vote of thanks, and spoke of the great difficulties with which the President had had to deal at different times during his presidency.

Dr. ODLING could not recall a president who had devoted so much time and attention to his duties as Dr. De La Rue. He had also achieved some difficult negotiations with a success which showed, in the highest degree, the esteem in which he was held, and the position which the Society had attained.

The proposal was carried by acclamation.

The meeting then proceeded to the election of officers, Messrs. Basset and Warrington acting as scrutators. The following are the names of the officers for the present year:—

President.—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents, who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De La Rue, Ph.D., F.R.S.; Thomas Graham, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Colonel P. Yorke, F.R.S.

Vice-Presidents.—J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.; John Stenhouse, LL.D., F.R.S.

Secretaries.—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Other Members of Council.—E. Atkinson, Ph.D.; J. Lothian Bell; E. T. Chapman; W. Crookes, F.R.S.; David Forbes, F.R.S.; D. Hanbury, F.R.S.; A. Matthiessen, Ph.D., F.R.S.; E. J. Mills; J. Prestwich, F.R.S.; Maxwell Simpson, Ph.D., F.R.S.; A. Voelcker, Ph.D.; C. Greville Williams, F.R.S.

Mr. FIELD proposed a vote of thanks to the officers and council for their efficient services during the past year, and associated with the vote the names of Dr. Redwood and Dr. Odling. For twelve years Dr. Odling had, with hardly a single exception, occupied the Secretary's chair at every meeting of the Society; and they could not allow him to conclude his secretaryship without thanking him for his kindness and courtesy, as well as for his successful endeavours to promote the welfare of the Society.

Mr. TUSON, in seconding the vote, also spoke in appropriate terms of the valuable services of Dr. Odling and Dr. Redwood.

The PRESIDENT said that the Secretary was the most active agent of the Society. Without active secretaries, the meetings would sometimes pass over without that intellectual food from which they derived so much benefit.

The vote was carried amidst great applause.

Dr. ODLING thanked the society for the kind manner in which they had expressed their satisfaction with the services of himself and Dr. Redwood, and referred to some of the changes which had taken place in connection with the Society during the thirteen years he had been Secretary, and also to the pleasure he had derived from being on terms of close acquaintance with the distinguished men who had filled the chair during his term of office.

A vote of thanks to the Scrutators brought the proceedings to a close.

Thursday, April 1st, 1869.

DR. A. W. WILLIAMSON, F.R.S., *President, in the Chair.*

THE list of presents to the Society was read, and a vote of thanks passed to the donors.

The following certificates were read:—

For the first time—E. Meusel, University College; A. W. Reinhold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

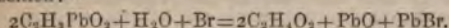
For the second time—J. T. Bottomly, M.A., King's College, London; F. Braby, Mount Henley, Sydenham Hill.

For the third time—W. H. Deering, 12, Surrey Square, Old Kent Road, S.E.

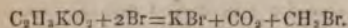
The last-mentioned gentleman was then balloted for and declared duly elected.

A paper by Messrs. E. T. Chapman and Miles H. Smith "On some Decompositions of the Acids of the Acetic Series" was then read. The following is an abstract:—

Action of Bromine on Acetate of Lead.—On adding bromine to an aqueous solution of acetate of lead, the authors found that a brown precipitate, consisting of peroxide of lead, was formed. On being warmed, the formation of the precipitate proceeded until 1 eq. of bromine had been added to 2 eqs. of acetate of lead. The following equation represents the decomposition:—



Action of Bromine on Acetate of Potash.—Two eqs. of bromine and one eq. of acetate of potash, and water, were sealed in a digestion tube for eleven hours. On cooling and opening the tube, CO₂ escaped, from which the mixture was freed by dilute caustic potash. The following change occurred:—

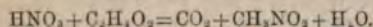


Action of Chlorine on Acetate of Potash in Aqueous Solution.—The action is strictly analogous to that of bromine. Bichloride of methylene is amongst the products of this reaction; and the authors think that, under appropriate circumstances, it would furnish a convenient source of this substance.

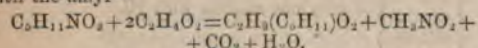
Action of Bromine on Valerianate of Soda in Aqueous Solution.—The products of this reaction are carbonic acid and bromide of butyl, more or less brominated. By fractional distillation of the liquid products, a body, having about the boiling point of bi-bromide of butylene, was obtained.

Iodine was found to have little action on the alkaline salts of the fatty acids.

Nitrate of Amyl and Acetic Acid.—On adding nitrate of amyl drop by drop to a warm mixture of twenty parts of glacial acetic acid and one of concentrated sulphuric acid, gases are evolved which consist of carbonic acid, a little nitrogen, a trace of binoxide of nitrogen, and an inflammable gas. The latter is soluble in solution of protochloride of iron, and proved to be nitrite of methyl. The liquid products of the reaction were acetate of amyl, with traces of acetate of methyl. Leaving out the amyl and the sulphuric acid, which takes no part in this or the following reaction, though causing them to take place, the reaction was as follows:—



With the amyl—

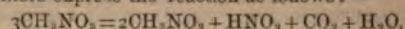


The acetate of methyl is supposed to owe its origin to a secondary reaction between the nascent nitrite of methyl and the excess of glacial acetic acid.

Nitrate of Butyl and Glacial Acetic Acid.—The action is precisely similar to the above, butyl being substituted for amyl.

Nitrate of Ethyl and Glacial Acetic Acid differ only from the above, in that the nitrate of ethyl decomposes, to some extent, by the heat of the reaction, and some of the products of the decomposition are obtained with the others.

Nitrate of Methyl and Glacial Acetic Acid.—The methyl of the nitrate of methyl is oxidised, and not the acetic acid. The authors express the reaction as follows:—



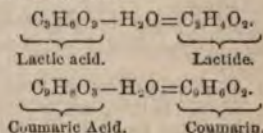
Action of Formic Acid on Nitrate of Amyl.—In the presence of sulphuric acid, these bodies give rise to formate of amyl, protoxide of nitrogen, carbonic acid, and water.

Mr. PERKIN remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of the other acids. In the case of acetic acid, he obtained chloride of methyl; and in the case of succinic acid, he obtained chloride of ethyl. He (Mr. Perkin) made an examination of the chloride of ethyl, and found that it produced the normal hydride, and behaved just as the normal chloride of ethyl.

The PRESIDENT asked Mr. Chapman under what conditions he got the chloride of methylene by the action of chlorine upon potassic acetate, whether with the presence of water or not?

Mr. CHAPMAN replied that all the decompositions occurred in the presence of water, with the exception of that in the case of glacial acetic acid. When the liquid was kept warm, and the chlorine passed into it pretty rapidly, being occasionally neutralised with potash, a notable quantity of chloride of methylene was formed, but it had to be looked for and condensed with care.

Mr. W. H. PERKIN, F.R.S., then made some remarks in reference to a paper published in the CHEMICAL NEWS* by Fittig, "On the Constitution of Coumarin and Coumaric Acid." Fittig assumed that coumarin was not formed from the hydride of aceto-salicyl, as had been stated, but that it resulted from the previous formation of coumaric acid. Some time since, Bertagnini stated that the hydride of benzoyl, when treated with chloride of acetyl, yielded cinnamic acid; and Fittig supposed that an analogous reaction took place between the hydride of salicyl and acetic anhydride, yielding coumaric acid, which, according to this view, would be oxycinnamic acid; this, by the further action of acetic anhydride, decomposing into coumarin and water. Coumarin would therefore be the anhydride of coumaric acid, standing in the same relation to coumaric acid as lactide did to lactic acid, thus:—



But the question was whether coumarin had the properties of an anhydride at all. It was formed in the plant, in the presence of water; and it might be crystallised from water any number of times without being changed. If boiled in strong potash, a saline compound of coumarin was obtained; but directly an acid was added it separated unchanged. On adding nitrate of silver to a well-saturated solution of coumarin in soda, a yellow precipitate was produced, which, on analysis, gave the formula of coumarin, plus oxide of silver, C₉H₆O₂Ag₂O. If it were an anhydride, it would yield, with ammonia, an amide; but it did not do so, and he thought it was very evident that it was not an anhydride, as Fittig supposed it to be. In fact, it was not an easy matter to produce coumaric acid from coumarin, a boiling supersaturated solution of caustic alkali being required.

The PRESIDENT thought that Mr. Perkin's statements decided very clearly the point which had been raised by M. Fittig; but to complete some of his statements, he would like to ask him if he had recognised the properties referred to in the artificial as well as in the ordinary coumarin?

Mr. PERKIN said that not only the artificial coumarin, but also the homologues, formed compounds with caustic

* Vol. xix., p. 73. (*Am. Repr. April, 1869, page 180.*)

soda; and, in the case of the homologues, as the soda concentrated on boiling, the new compound separated as an oily layer, which, on cooling, became a sticky mass.

The PRESIDENT remarked that it was not conceivable that an anhydrous acid on boiling with water and an alkali should remain as an anhydrous acid capable of falling down as such upon the addition of an acid. He thought Mr. Perkin's evidence was quite conclusive.

Mr. PERKIN, on trying Bertagnini's experiment with the hydride of benzoyl and chloride of acetyl, had not yet succeeded in obtaining cinnamic acid. He did not know whether any gentlemen present had succeeded in obtaining it. He intended to repeat the experiment, and hoped to be more fortunate.

The PRESIDENT thought the absence of the action of ammonia on coumarin very conclusive that it could not be an anhydrous acid. He thanked Mr. Perkin for his communication, and announced that the next meeting would be held on the 15th inst.

Thursday, April 15th, 1869.

DR. A. W. WILLIAMSON, F.R.S., *President, in the Chair.*

WHEN the minutes of the preceding meeting had been read,

Mr. CHAPMAN said that several gentlemen had questioned him about the action of nitric ethers on acetic acid, and he supposed he must have forgotten to mention that the decomposition only occurred in the presence of concentrated sulphuric acid.

After a slight discussion, in which it was stated that the report in the CHEMICAL NEWS was correct, the words "In the presence of sulphuric acid" were ordered to be inserted in the minutes, which were then confirmed.

The certificates of the following gentlemen were read for the second time:—E. Meusel, University College; J. M. Muir, Shortland, Thames Gold Field, New Zealand; and A. W. Reinold, Merton College, Oxford.

The certificates of J. T. Bottomley, M.A., Demonstrator of Chemistry, King's College, and of F. Braby, F.G.S., were read for the third time, after which the gentlemen were balloted for, and duly elected.

Mr. CHAPMAN read a paper by himself and Mr. M. H. Smith "On Propyl Compounds Derived from the Propylic Alcohol of Fermentation."

They operated on that portion of fusel oil which remained after the amyl, butylic, and ethylic alcohols had been as perfectly as possible removed. It boiled from 79° C. to 106°. It was converted into bromides, and the bromides fractionally distilled. From the mixture of bromides, the bromide of propyl is separated by fractional distillation without much labour. It is a colourless liquid, boiling at 70½° C., and of sp. gr. 1.3532 at 16° C. The alcohol was obtained from the bromide by converting it into acetate, by digestion with acetate of potash and acetic acid. The acetate so obtained was contaminated with traces of bromide, to remove which it was digested with strong ammonia, which converted the bromide into bromide of propylamine, and the acetate partially into the alcohol. The mixed alcohol and acetate were treated with caustic soda, whereby it was at once and completely converted into the alcohol.

The alcohol is a colourless liquid of strong but not oppressive odour; it boils at 97° C., and its sp. gr. is 1.8120 at 16° C. On oxidation it yields propionic acid.

The iodide was prepared from the alcohol but digestion with excess of strong hydriodic acid; it boils at 102° to 103°, and has a sp. gr. of 1.7343 at 16° C.

The iodide and bromide yield no olefine on treatment with alcoholic potash.

Mr. CHAPMAN then read a note "On Bromide of Amyl" by himself and Mr. M. H. Smith.

They prepared bromide of amyl by the action of hydrobromic acid on amyl alcohol. They find the bromide has

not been correctly, though variously, described. According to these observations, it is a mobile liquid, boiling at 121° C., and of sp. gr. 1.2173 at 16° C. They drew attention to the fact that the intervals between the boiling points of the bromides of methyl, ethyl, and propyl are constant, viz. about 29° C.; that between bromide of propyl and bromide of butyl is only 22°, but that the interval between the bromides of butyl and amyl is again 29°.

				Differences.
Bromide of methyl boils at	13°	}	}	29
" of ethyl " at	42°			
" of propyl " at	70½°			
" of butyl " at	92°			
" of amyl " at	121°				29

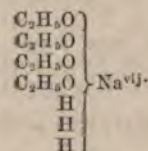
They explain this by the fact that the butyl and amyl are not normal radicals.

They express a doubt as to the possibility of obtaining pure bromide of amyl by the action of bromine and phosphorus on the alcohol.

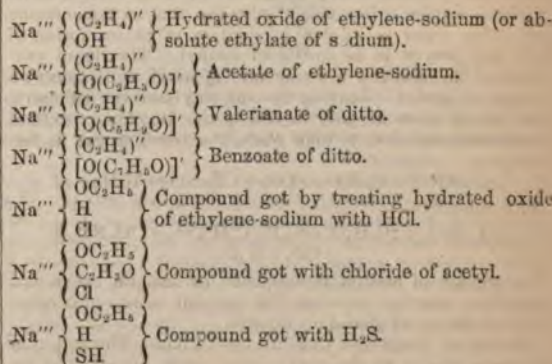
The PRESIDENT thought the subject of the paper particularly important. Every addition to their knowledge of organic chemistry was of value. He thought that on a former occasion Mr. Chapman made a statement regarding the origin of fusel oil, when he (the President) was unfortunately absent.

Mr. CHAPMAN explained that the fusel oil in question was about twelve or thirteen years old, and was obtained at the time when there was a demand for amylene. He had operated on the lower portion.

Professor WANKLYN made a verbal communication touching the atomicity of sodium. He said that the researches which had occupied him during the last few months had tended to convince him that sodium was an eminently polyvalent element. The crystalline compound obtained by acting on excess of absolute alcohol with sodium, and which was endowed with great stability, bearing a temperature of 100° C. without alteration, had the empirical formula $C_{12}H_{22}NaO_4$. In this compound sodium appeared to be seven-valent, thus:—



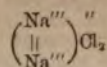
In a great number of compounds which had been recently produced in the course of the investigation, sodium occurred in at least a three-valent state, thus:—



Many other such compounds can doubtless be produced, inasmuch as the hydrated oxide of ethylene-sodium manifests this tendency of combining with so many various reagents.

The common sodium compounds are regarded by Professor Wanklyn as being not, properly speaking, compounds

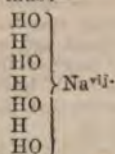
in which sodium is mono-valent, but complex compounds, thus:—



is common salt.

The PRESIDENT remarked that the question of the equivalent value of elements was one in which there was, at present, room for difference of opinion. Mr. Wanklyn's views were likely to be useful if followed up by himself and other members, so as to come to a distinct and definite decision. He thought that in many parts of their progress in science, they attended too exclusively to one particular order of phenomena, without comparing their conclusions with other parts of science. Until they obtained a compound of sodium with three monads, they must have some hesitation in assigning to it, as a general principle, the classification of triad functions. At the same time, it seemed to him quite natural to suppose that a monad, such as sodium usually appeared to be, might, in certain cases, act as a triad. But it was a question whether it was more in accordance with its general behaviour to assign to it those functions which it appeared, in exceptional cases, to assume; or to say that sodium was a monad, and to explain the exceptional cases by the special hypothesis which seemed to suit them best. Mr. Wanklyn was probably aware that many of them might be represented as a monad to sodium. Sodium, combining with three of acetylene, seemed to favour Mr. Wanklyn's view; but when they had three times that group—acetylene, two carbon, and one oxygen, a union amongst those elements themselves might be conceived, forming a radical which might itself be monadic, and that circumstance was the difficulty in organic bodies. He (the President) thought that organic bodies must generally obey those principles, which were clearly established among mineral compounds.

Mr. VERNON HARCOURT could not understand why it was more natural to suppose that the combination of those molecules of alcohol which had been regarded as a molecule of sodium and alcohol should not be rather analogous to the water of crystallisation with any hydrate or any other salt. In the instance before them they had, besides sodium hydrate, other combinations of the sodium hydrate; when the solution was evaporated they obtained crystals—he did not remember whether they contained three molecules of water of crystallisation, but, following Mr. Wanklyn's formula, he would write them thus:—



Supposing that the crystals contained three molecules of water of crystallisation, there would be a compound similar to that of the new sodium alcohol, which would furnish an argument, and a very weak one, for regarding the sodium as being heptatomic.

Professor WANKLYN regarded the combination of salts with their water of crystallisation as real compounds. If a great deal of maltreatment was necessary to break up the hydrate of sodium, he would consider the combination as good a chemical compound as any he knew. If a compound, containing the elements of alcohol and chloride of sodium, were admitted to be a genuine chemical compound, and if the ordinary values were assigned to the carbon, oxygen, and chlorine, could it be expressed otherwise than by writing sodium as triatomic? With regard to the ordinary sodium compounds, he considered that the sodium was merely complex sodium, or diatomic.

A slight discussion ensued between Dr. Debus and Mr. Wanklyn as to water of crystallisation, &c., of compounds, after which

Mr. CHAPMAN said that unless they were prepared to abandon the atomicity theory, they must admit that when two compounds unite, they have a bond with which to hold themselves together. If they had a certain compound of chloride of sodium with anything else, he thought that they had nearly perfect proof that either chlorine or sodium—most probably both—were not monads; otherwise there was no reason why the compound should hold together. It could only enter into combination with another body if that body was diatomic, and then only by splitting up into its elements in doing so.

After some further remarks by Dr. Debus, Mr. Chapman, and Mr. Newlands,

The PRESIDENT said it was very important to know what was meant by *atomicity* in contradistinction to *equivalence*. He thought the words had received a very distinct definition, which really ought to be adhered to. The only difference he knew in the consistent use of the word was, that *atomicity* was a real or untrue kind of equivalent which was rigid, absolute, and unchangeable. They had used the word in a very different sense that evening, and he thought in one that ought to be conveyed by the word *equivalence*. Introducing such words as *bonds* he believed quite unnecessary, because a "bond" was a physical image, and nothing whatever could be expressed by that word which could not be expressed without it. The habitual use of such a word must be productive of very considerable injury to the theoretical habits of those who used it. He would not express any opinion as to whether the atomicity theory was right or the equivalence theory, but they were different. For his own part, he thought the rule was to find that elements were capable, under different conditions, of assuming different equivalence of value; but it was, he thought, going a little further than the fact, to say they must all be capable of that; the common case was that elements changed their equivalent value, and it was reasonable to suppose they all did so, and by increments of two.

The Society then adjourned.

GLASGOW PHILOSOPHICAL SOCIETY.]

(CHEMICAL SECTION.)

A MEETING was held in the Upper Hall of the Glasgow Art Gallery on Monday, the 29th inst., at eight o'clock in the evening. W. R. Hutton, Esq., in the chair.

Two new members were admitted by ballot, and one candidate was proposed.

The following papers were read:—"On the Examination of the Flame of the Bessemer Converter," by THOMAS ROWAN, Esq., F.C.S.; "On the Effect of Phosphorus on Iron," by THOMAS ROWAN, Esq., F.C.S.; "On the Quality of Compound Molecules," by J. CAMERON, Esq. We intend to give a further notice of these papers as space permits.

NEWCASTLE CHEMICAL SOCIETY.

THE fourth general meeting of the Society was held on the 25th inst., the President in the chair.

Seven new members were elected. Dr. LUNGE read "Notes on the Progress of Foreign Analysis during 1868." Mr. J. W. SWAN exhibited and described a powerful Holz induction machine.

THE concluding meeting of the Society was held on Thursday, the 22nd inst., the President, J. L. BELL, Esq., in the chair.

Dr. LUNGE read an "Abstract of the Contents of the *Annales des Mines*, for 1868."

Mr. BOWMAN read an "Abstract of M. Caron's Pamphlet on *Magnesia as a Furnace Material*."

Mr. B. S. PROCTOR read a "Note on Medicinal Rhubarb."

FRENCH ACADEMY OF SCIENCES.

Monday, March 22nd, 1869.

AMONG the papers read we notice and briefly abstract the following:—"On the Luminosity of Geissler Tubes by Friction." M. ALVERGNIAT calls attention to the fact, that by simply rubbing one of the aforesaid tubes with the dry hand or a piece of silk, it exhibits the same phenomena of luminosity as if induced by electricity; the phosphorescence is, however, weak, but may be increased when within the tube are deposited substances which may become phosphorescent under the influence of electricity; when a tube so arranged is quickly rubbed it becomes within a few moments sufficiently luminous to serve as a faint light to see in a dark room.

Professor Dr. G. CHANCEL read a paper "On the Ethers of the Propylic Alcohol derived from Fermentation." He begins with a statement that his researches on this subject are not yet sufficiently advanced to enable him to give complete details; propylic ether, or oxide of propyl—



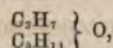
is obtained by the action of iodide of propyl on the propylate of sodium. The oxide of propyl boils at about 86°C ., and is a liquid exhibiting a high refractive power, slightly soluble in water. When the iodides of methyl, ethyl, and amyl, are suffered to act upon propylic alcohol in the presence of potassa, compound ethers are obtained, e. g., propyl-methyl ether, or oxide of propyl and methyl—



which boils at between 49° and 52°C .; propyl ethylic ether, or oxide of propyl and ethyl—



which distills over at about 86°C .; propyl amyl ether, or oxide of propyl and amyl—



which boils between 125° and 130°C . All these liquids have a density varying between 0.75 and 0.80, and exhibit a peculiar ethereal odour, as of ordinary ether mixed with some strange odoriferous principle.

M. E. J. MAUMENÉ presented a note "On the Action of Corrosive Sublimate on Biniodide of Ethylene." The author first reminds, that some years ago he called attention to the fact that Berzelius and other authors had not paid proper attention to the reactions which in this instance take place, and Maumené comes to the conclusion that Berzelius had not even had prepared biniodide of ethylene, but mistaken iodoform in its stead. Sérullas, Mitscherlich, Bouchardat, and others, are then criticised, and the author next goes on with a series of theoretical reasonings not directly supported by experiments, but entirely founded on algebraico-chemical formulae and reasoning; by these means he proves that, not as was stated by Berzelius, iodide of carbon is the result of the reaction, but that either a chloriodide of ethyl or a chloride of ethyl is formed. The learned author ends his paper with this dictum: All chemical actions can be beforehand proved by theory; all formulae which do not agree with it, will be rejected by experiments.

Monday, March 29th, 1869.

THIS meeting was one of very little interest for the scientific public generally; being chiefly occupied by the reading of correspondence relating rather to history.

The Rev. Father SECOUR, S.J., made an interesting communication in reference to the spectroscopical research

made by him of the light emitted from the planet Uranus. This light, it appears, differs from that of the rest of the planets belonging to our solar system. The spectrum shown by the light of this planet, exhibits broad absorption lines; so that the yellow colour is almost entirely wanting—absorbed. While it is clear that the light emitted by this planet is reflected light from our sun, it is evident that the surface of the planet modifies that light in the same manner as do coloured bodies.

The Rev. Father also communicated, that the spectrum of R. Gemini, a so-called variable star, clearly exhibits, when at its greatest brightness, the lines due to hydrogen, magnesium, and sodium.

Monday, April 5.

AT this meeting a large number of papers were read, but the major portion does not belong to the sciences treated of in the CHEMICAL NEWS. Among those which may interest our readers, we briefly mention the following:—A very short communication from Dr. Maumené, in respect of "The Action of Potassium upon Dutch Liquid." Many of our older readers will perhaps recollect the very sharp discussions on this subject which, a long time ago, took place between Dumas and Liebig; Maumené now proves that both those eminent savants were right, since the diversity of the results obtained by them is entirely due to the fact that one of them applied the liquid in excess, the other the metal.

M. GAUGAIN read a paper wherein he proves that, even with feeble galvanic currents, the electrodes are always polarised, and that this polarisation is constant when the relation between the intensity and the resistance remains constant.

M. BERTHELOT read a paper "On the Influence of Pressure on the Reaction between Carbon and Hydrogen," of which paper we propose to give a full report afterwards. We intend to do the same with the paper read by MM. Schützenberger and Naudin, "On the Acetic Acid Derivatives of the Carbo-Hydrates"; we therefore briefly now state that, according to their researches, starch-paste has to be considered as an alcohol, since it can combine with acids and form definite compounds.

M. DUBRUNFAUT made some rather unexpected statements in respect of the impurities of refined sugar, which will startle refiners as well as consumers; the learned gentleman has, however, made *beaucoup de bruit pour peu de besogne*, and has entirely ignored the series of analyses of sugar made both by means of the *saccharimètre optique*, and by very carefully executed and well-devised chemical methods by Professor Mulder, executed some years ago, which proved properly refined sugar, as ordinarily met with in commerce, to be almost chemically pure; and, after all, M. Dubrunfaut does not find anything worse than about 0.01 per cent of glucose, and a very small proportion of ash.

In order to elucidate the history of nitrification, M. HOUZEAU made a communication in reference to his experiments on the surface soil of Lower Egypt and also of the island of Noirmoutier. His results confirm Lavoisier's opinion, that nitrates are the produce of the slow combustion of certain organic substances placed under favourable circumstances.

M. FEA proposes, in order to prevent the accidents of gas explosions in coal-pits, to place along the roofs thereof platinum wires rolled up in spiral form, and to make these red-hot by means of an electric current, thus ignite cotton wicks previously steeped in molten sulphur, and, moreover, provided with a phosphorus match composition, and to set fire, by this means, to the gas always present in the pits. It need hardly be mentioned that Boussingault very properly observed thereupon that, since the accidents of this kind in coal-pits are chiefly due to sudden outbreaks of gas, and especially to a sudden variation of atmospheric pressure, this plan would not at all answer the purpose, the less so as, according to Combes, a velocity of the gas current, from 2.5 to 3 metres to the second of time, renders the safety-lamps also inactive.

M. KOERNER communicated that he has succeeded in ob-

taining a base which is isomeric with toluidine, by bringing crystallised monobromated toluol into well-cooled strong nitric acid; he thus first obtains mononitrated bromotoluol, a sulphur-yellow coloured fluid. By treating this fluid first with tin and hydrochloric acid, and the result of this reaction next with sodium-amalgam, the new toluidine is produced; this is a colourless liquid, having about the same specific gravity as water, boiling at 198°C ., and yielding, with acids, well-defined salts.

MM. DE LAIRE and GIRARD made a brief communication concerning the influence of pressure when reactions take place in closed vessels, such as sealed tubes. Among the results obtained by them we notice that increase of pressure does not favour the formation of diphenylamine; that increase of temperature, on the other hand, favours the production of that substance; while increase of pressure paralyses, so to speak, the good influence of temperature.

Monday, April 12th, 1869.

THE first paper read at this meeting, was one on the "*Synthesis of a New Butylen—the Ethyl-Vinyl*," by M. Ad. Wurtz.

This substance may be obtained by two entirely distinct methods; either by suffering the iodides of the alcohol radicals to act upon sodium, or by making the alcoholic bromides react upon zinc ethyl. By the first method, the author obtained methyl-allyl; by the second, the vinyl-ethyl has been obtained. This is, at ordinary temperature, a gas, but becomes a liquid at -5°C . With bromine, it forms a bromide, boiling at 166° . Submitted to the action of hydriodic acid, and heated in a sealed tube, a liquid is obtained which is very similar to iodide of butyl, boiling, as the latter does, at 121° . The specific gravity of this iodide of ethyl-vinyl is 1.634; it differs from the iodide of butyl by its behaviour with acetate of silver, in contact with which the iodide of ethyl-vinyl is decomposed, forming an acetate, boiling at 110°C .

The author does not, for the present, desire to enter into further details, which he reserves, after having more accurately studied the origin of this substance.

Methyl-allyl boils at about 159°C ., and has, at 0°C ., a specific gravity of 1.8299.

The other papers read do not belong to the domain of sciences treated in our paper.

We read, however, under the same heading as above, in *Cosmos*, something which may find conveniently a place here. It appears that the well-known Swiss *savant*, De la Rive, is at present at Paris, and engaged in studying the propagation of electricity in gas and rarefied vapours. His assistant, Dr. Sarrazin, has noticed some hitherto unknown phenomena of phosphorescence. As soon as pure oxygen is reduced to a pressure of only two millimetres or less, it becomes exceedingly luminous under the influence of electricity. No other known gas is possessed of this property. All compound gases which contain oxygen become also luminous, and most so the protoxide of nitrogen. The Doctor has found that the cause of this phosphorescence is due to the formation of ozone, since it does not take place when, previous to passing an electric current through the gas, powdered metallic silver has been introduced into the space containing the gas, but the silver becomes rapidly oxidised.

While engaged in studying the part which sulphuric acid plays in these phenomena, Dr. Sarrazin found that when a small quantity of this acid, which is considered non-volatile at ordinary temperatures, was confined along with nitrogen gas, for instance, in a gas jar, and an electric current passed through, a very intense luminosity was caused, notwithstanding nitrogen is not by itself rendered luminous under these conditions. The author found that there was decomposition of sulphuric acid, with formation of ozone, and that the phenomena ceased when powdered silver was introduced.

Monday, April 19th, 1869.

AMONG the large number of papers read—some of which do not interest us, being either purely mathematical, astro-

nomical, or belonging to applied mechanics—we meet, in the first place, with a brief note from M. Delaporte concerning the communications made by MM. Cailletet and Berthelot, on the part pressure plays upon some chemical phenomena; since that note is, however, purely theoretical reasoning, not supported by any experiments, and while it, moreover, does not advance our real knowledge about this question at all, the President thought it ought not to be discussed.

M. J. E. PETREQUIN read a short paper "*On the Cerumen contained in the Human Ear*." This substance had been analysed by Vauquelin, and also many years ago by Berzelius; the recent researches of the author prove that it contains about one-tenth of its weight of water; a fatty substance made up of oleine and stearine; a potassa soap soluble in water and alcohol, insoluble in ether at the ordinary temperature of the air; also another potassa soap, insoluble in alcohol, but soluble in water; lastly, an organic substance insoluble in water, ether, and alcohol, containing, moreover, lime, potassa, and soda.

M. RABACHE proposed, instead of expressing the equivalents of the elements as multiples of the equivalent of hydrogen taken as unity, that the figure should be 0.25, as this would simplify the tables of equivalents.

M. DUMAS observes thereon that the equivalent of potassium is not the multiple of 0.25, or $\frac{1}{4}$, but of $\frac{1}{2}$, and moreover states that really there is no warrant for any such change at all.

M. SORET communicated that, after having read Professor Tyndall's note "*On the Clouds*," he had felt induced to examine, by means of the polariscope, the beautifully blue colour exhibited by many parts of the lake of Geneva, and he stated that this colour was due to the presence of solid particles in the water and of the same specific gravity as that fluid; but he does not say what these particles are nor what size or shape they have, promising, however, further researches.

M. DUBRUNFAUT stated as the conclusion he has been brought to by a series of researches on supersaturation, solution, and superfusion, that the molecular constitution of dissolved substances is different from that which the same substance exhibits when crystallised.

M. DUMAS performed, at this meeting, the following experiment in order to illustrate the paper "*On the Action of Heat upon the Peroxide Salts of Iron*," by M. Debray:—In a large portion of distilled water some few drops of a neutral solution of chloride of iron are poured, care being taken not to apply so much of the salt that its colour is at all imparted to the water; on heating the liquid gradually up to, and above, 70°C ., it becomes perceptibly brown-coloured. When that moment has arrived, the water no longer contains chloride of iron, but instead a mixture of free hydrochloric acid and free peroxide of iron; the limpidity of the fluid is not, however, at all impaired. In order to prove this, it is only requisite to pour into the fluid a solution of common salt, whereby the static equilibrium of the liquid is disturbed and the oxide of iron precipitated. When the experiment is made in sealed tubes, and the latter heated to between 200° and 300°C ., crystalline oxide of iron is precipitated.

MM. FRIEDEL and LADENBURG sent a paper on the preparation and properties of a compound which only differs from oxalic acid by the substitution of silicon for the carbon of the acid just named. We intent to return to this paper, and also to publish the interesting papers on the areometer of Baumé, by M. Baudin, and that on the essence of sassafras, by M. Grimaux.

M. MAUMENÉ communicated some further researches made by him "*On the Action of Potassium upon Dutch Liquid*," the result of which is that, when the metal is in excess, three gases are given off, but when the liquid is in excess, only one of these appears, while the two others remain in solution.

MM. CHAPÉLAS-COULVIER-GRATIER, E. ROBERT, and TRE-

MESCHINI described at this meeting the brilliant aurora borealis seen at Paris on the night of the 15th inst., from a quarter past nine until about eleven o'clock; the phenomenon was remarkably developed, completely occupying the N.E. to the W.N.W. portion of the sky. It appears that not only the very sensitive magnetic instruments at the observatory, but even those at the telegraph stations, were perceptibly disturbed.

PHARMACEUTICAL SOCIETY.

Wednesday, April 7th, 1869.

G. W. SANDFORD, Esq., *President, in the Chair.*

MR. HOWARD made a few remarks with reference to the cultivation of cinchona in India, dwelling more particularly on the necessity of discriminating between the embarrassing number of varieties and species now under cultivation, owing to the great variation in the amount of their respective yields. In respect to the effects of cultivation on the productiveness of the bark, it appeared that the cinchonine increased in greater proportion than the quinine.

Dr. REDWOOD read a paper in which he proposed that the question of the expediency of changing our present system of weights and measures for the metric system should be discussed. The abstract question itself was, without doubt, accepted on all sides; the only objection to be raised was a question of the balance of advantages attending its adoption and the inconveniences to be encountered in introducing it. With the public it was only a question of familiarity, and it was proposed on many sides to patch the old system rather than revolutionise and adopt a new system in its entirety. In deciding against such patchwork, and in favour of the metric system, entire dissatisfaction with the old, or unqualified approval of the new system was not expressed. It was sometimes lamented that our measures were not accurately defined on scientific principles, whereas it was asserted the standards of the metric system were so defined. This was an entirely erroneous assumption, and was only true of our system when the inch was said to be the measure of three barley-corns, the foot the length of a man's foot, &c. The metre of the metric system was not selected because it was the most useful measure, but because it was the 10-millionth part of a certain portion of the earth's surface. In basing the standard measure of our system on the vibrations of a seconds pendulum, we have not sought a unit of measurement, but simply to determine the length of the inch from which all the old established measures might be derived. Moreover, it had been found preferable to refer measures to a carefully preserved artificial standard, so that the metric system does not owe its superiority to its natural standard, but to the comparability of its divisions, which enable it to be adopted as an international system. The author also recommended that pharmaceutical chemists should be impressed with a definite notion of the integral parts of the system, not simply acquainted with its principles, and mentioned a variety of plans by which this object could be attained. He considered that it would greatly facilitate matters if the names now in use in France were anglicised so as to conform more to English notions. The valuable opinions of the Master of the Mint were also quoted and discussed by the author. As a partial measure, the total abolition of troy weights had recommended itself to Dr. Graham's mind; and Dr. Redwood inferred from the general tone of his report that no sweeping change could be expected just now.

After a slight discussion, in which Dr. Attfield, Mr. Haselden, and Mr. M. Carteghe took part, it was proposed and carried, that the further discussion of the subject be adjourned; and the President announced an extraordinary meeting to be held for this purpose on Wednesday evening, May 5th.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 5th, 1869.

"On some further Results of Spectrum Analysis as applied to the Heavenly Bodies," by WILLIAM HUGGINS, F.R.S.

—The speaker commenced by saying that four years ago he had the honour to give in the theatre of the Royal Institution an account of the results of an attempt to apply the method of analysis by the prism, for which science is indebted to Kirchhoff, to the light of the heavenly bodies. It was the speaker's purpose to describe, on the present occasion, some of the results which had been obtained in his observatory since the Spring of 1865. The peculiar suitability of spectrum analysis as a mode of investigation of the bright objects in the heavens had been confirmed, not only by the gain of further information of the chemical and physical constitution of some of these immensely distant bodies, but also by knowledge of another kind which this elegant and searching method of analysis had revealed to us.

The speaker then described the three typical forms under which all spectra may be classed, and the interpretation which our present knowledge enables us to give of these different spectra when the light is emitted by bodies rendered luminous by heat. The spectra of fluorescent and phosphorescent bodies were not to be described.

1. *A continuous spectrum without dark or bright lines* shows, as a general rule, that the luminous source is in the solid or liquid state. In certain exceptional cases, however, a gas may give a spectrum which is apparently continuous. Dr. Balfour Stewart pointed out that, as gases and vapours possess a power of general absorption, in addition to the selective absorption peculiar to each gas, a gas when luminous would emit light of all refrangibilities, producing a continuous spectrum, in addition to its spectrum of bright lines, and further that the intensity of this continuous spectrum would be in proportion to the opacity of the gas. The researches of Plücker and Frankland have shown that, under certain conditions of density and temperature, the bright lines of hydrogen expand so as to produce a spectrum which is apparently continuous.

2. *A spectrum of bright lines* indicates that the luminous body is in the state of gas. Each gas and vapour has its own set of lines. The lines may be greatly modified, or even altogether changed, under different conditions of temperature and density, as is well known in the case of nitrogen, the vapour of sulphur, and some other substances; but throughout all these changes, each gas behaves in a way peculiar to itself. There appears to be one exception to the statement that a spectrum of bright lines is peculiar to luminous gas. Bunsen found that when solid erbia is heated to incandescence, the continuous spectrum contains bright bands.

3. *A continuous spectrum interrupted by dark lines* informs us that the light has passed through vapours at a lower temperature than the source of light. As the kinds of light absorbed by each vapour correspond precisely with the set of bright lines which that vapour emits when in the luminous state, it is possible to learn if the vapours are those of any of the substances with which we are acquainted.

The speaker said that, following the arrangement adopted in the former discourse, the most important recent information obtained of the *fixed stars* results from the application of prismatic analysis in a new direction. Under certain conditions the spectrum of a luminous body is adapted to tell us whether that body is moving towards or from the earth. The importance of information on this point will be seen from the consideration that the proper motions of the stars represent that part only of their whole motion which is transverse to the line of sight; for any motion they might have in the visual direction, toward or from the earth, would not cause any visible displacement of the star, and could not therefore be ascertained by the ordinary methods of observation.

As it is upon the length of the waves, or upon the number contained in the series that enters the eye, or falls upon the prism, in a second that a judgment is formed of the colour of the light, or its place in the spectrum is determined, it follows that any circumstance which would alter the length of the waves *relatively to the observer*, or, in other words, cause a larger number of waves to enter the eye in a second of time, would cause a change in the colour or refrangibility of the light so far as the observer is concerned. It is obvious that if the observer advances to meet the light, a longer series of waves fall upon the retina in a second of time, each wave appears shorter, and he ascribes to the light a higher refrangibility than he would do if he were not advancing to meet the light. If he were receding from the star, an alteration of refrangibility in the opposite direction would take place. The same effect would ensue if the luminous source were in motion. Thus, to a swimmer striking out from the shore, each wave appears shorter, and he passes a greater number of them in a given interval in proportion to his speed through the water.

Illustrations were given of this principle, which was first suggested in 1841, by Doppler, by means of an analogous change of pitch in sound. Two tuning-forks sounding in unison were moved rapidly towards and from the audience, when beats were heard, which told of a difference of pitch produced by the opposite motions of the forks.

As there exists beyond the visible spectrum, at both ends, a store of invisible waves, these would be advanced or degraded into visibility, in proportion as the colours of the spectrum were altered, and no change of colour would be perceived. It is therefore essential, before we can apply this method to detect the radial motion of the stars, that we know the original refrangibility of some part of the light at the moment it left the star, and also that we are able to recognise this particular part of the light again in the spectrum of the star's light. When, by means of a group of dark or bright lines, we learn the presence of a terrestrial substance in the star, both these conditions are fulfilled.

Of all the stars which the speaker had compared with terrestrial elements, when working with his distinguished friend Dr. W. A. Miller, Treas. R. S., Sirius, which contains four very strong lines which are due to hydrogen, appeared the most suitable for this investigation. The apparatus employed, and the special precautions which were taken to ensure the perfect coincidence in his instrument of the stellar line with those of the substance compared with it, were described by the speaker, who stated that, after a prolonged comparison, extending over many weeks, of the line of hydrogen in Sirius in the green, at the place of *F* in the solar spectrum, with the line of terrestrial hydrogen, he found that the line in the star had undergone a shift in the spectrum equal to a difference of wave length, which would correspond to a motion of recession between the star and the earth of 41 miles per second. The speaker had obtained evidence from experiment that this shift was not due to unsymmetrical expansion of the line in hydrogen as the density is increased. The greater width of this line in Sirius than in the solar spectrum would show that the hydrogen in Sirius, though at a pressure considerably less than that of our atmosphere at the surface of the earth, is more dense than the hydrogen in the solar atmosphere by which the dark line *F* is produced. This conclusion is in accordance with the presumably enormous mass of Sirius, as suggested by its great intrinsic splendour.

The earth at the time of observation was moving from Sirius at about 11 miles per second, which would leave 30 miles as due to the star. A further correction is required for the solar motion in space, which is believed to be towards Hercules, with a velocity of 4 or 5 miles per second. The whole of this must therefore be deducted, leaving about 26 miles as the motion of Sirius from the earth in the line of sight. The true motion of the star would consist of this radial motion compounded with the transverse motion of from 24 to 40 miles per second, which is shown by its proper motion.

The speaker then described a further examination of the

nebulae (about fifty have been successfully observed) with a more powerful spectroscopic, which confirms his previous conclusion that these bodies consist mainly of the gases nitrogen and hydrogen. He also found that when the spectra of these gases are made faint by the removal of the spark to a distance, all the lines are extinguished, with the exception of the one line in each spectrum which is found in the nebulae. If such an extinction takes place in the case of the nebulae, since they are objects of sensible size, it must be attributed to a power of extinction of light existing in cosmical space.

Observations of four comets have been made. A large part of the light of these strange objects was found to be peculiar, and therefore emitted by the cometary matter. Brorsen's comet at its return in 1868, and a comet discovered by Winnecke, gave a spectrum of three bright bands. The spectrum of Winnecke's comet (comet II., 1868) was found to be identical with the spectrum of carbon as it appears when the induction spark is taken in olefiant gas, and in some other compounds of carbon. The spectrum of the comet was compared directly in the instrument with the spectrum of olefiant gas.

The speaker then described some observations of the sun. He found that while the solar lines are for the most part thickened when viewed in the light from the umbra of a spot, the lines *C* and *F*, due to hydrogen, did not appear to be altered. This observation is of interest in connection with the constitution of the solar prominences as shown by the observations of the great eclipse of last August. The speaker, nearly three years ago, at the same time that he had independently made attempts to see the prominences by means of the spectroscopic, also tried the method of using absorbing media, by which the parts of the spectrum where the bright lines occur might remain, while all the rest of the spectrum was extinguished. In this way the faint prominences would be rendered visible, in consequence of the much greater relative diminution of the intensity of the illuminated screen of air, which, on ordinary occasions, conceals them from view. Recently he had succeeded in viewing the outline of these objects by means of a coloured glass combined with a spectroscopic with a wide slit. He expected to be able to view these objects by means of coloured media alone.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 6th, 1869.

E. W. BINNEY, F.R.S., F.G.S., *Vice-President, in the Chair.*

DR. JOULE, F.R.S., gave an account of his endeavours to improve the instrument known as the *dip circle*.

A paper was read "*On the Chemical formula of Alizarine*," by EDWARD SCHUNCK, Ph.D., F.R.S., &c. (See page 193. *Am. Repr.*, June, 1869, page 300.)

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Analysis of a Meteorite (*Cosmos*), known as the meteorite of Wisconsin, U. S. Specific gravity, 7.82; composition in 100 parts:—Iron, 91.03; nickel, 7.20; cobalt, 0.53; phosphorus, 0.14; copper, a trace; insoluble in hydrochloric acid, 0.45.

Decomposition of Alkaline Chlorides.—(*Moniteur Scientifique*, No. 295.)—According to Messrs. Kuentz and Jossinet, the decomposition of alkaline chlorides is readily and economically effected by the combined agency of heat and high-pressure superheated steam; the chlorides are brought to fusion, and while in that state a jet of steam, as just described, is forced through the fused mass; hydrochloric acid is formed together with a caustic alkali, or if, at the same time, carbonic acid is injected along with the steam, the carbonate of the alkali is formed.

Reduction of Chloride of Silver.—(*Zeitschr. f. Anal. Chem.*)—According to Gräger, an ammoniacal solution of chloride of silver is very completely reduced by placing therein tolerably large lumps of zinc; the solution is best placed in a wide-mouthed glass stoppered bottle, and this requires to be shaken frequently; there should be zinc in excess. When the fluid, on a drop thereof being tested, no longer yields a precipitate with hydrochloric acid, the operation is finished; the silver is then separated by pouring the fluid off from the spongy mass, and washing by decantation; the pieces of zinc having been removed, the spongy silver is washed with pure strong hydrochloric acid, and next with water. The silver thus obtained is, according to the author, chemically pure.

On the Action of Sulphuretted Hydrogen Gas upon Oxide of Iron and Hydrated Oxide of Iron.—(*Journ. f. Gasbeleuchtung*, 1869, No. 2.)—M. E. Brescius, at Frankfurt-on-the-Maine, has instituted a series of long-continued experiments in reference to the above subject and its special bearing upon the illuminating gas purifying process, known as "Laming's," when lime purifiers are applied not simultaneously for the purpose. As result of the researches and experiments of Brescius we find—1. That when sulphuretted hydrogen gas acts upon hydrated oxide of iron at the ordinary temperature of the atmosphere, there is formed sesqui-sulphuret of iron, Fe_2S_3 , according to the formula— $\text{Fe}_2\text{O}_3 + 3\text{HS} = \text{Fe}_2\text{S}_3 + 3\text{H}_2\text{O}$. 2. Perfectly dry sulphuretted hydrogen gas has no action whatever upon perfectly dry oxide of iron. The experiments are fully described in a lengthy paper.

New Preparation of Dithionate of Soda, &c.—(*Les Mondes*.)—On shaking nitrite of oxide of amyl with a solution of bisulphite of soda, the dithionate is obtained in the form of a white crystalline mass. The method for the preparation of hyponitric acid, by means of nitric acid and arsenious acid, does not give a pure product. If nitrite of oxide of amyl is treated with chlorhydric acid, hydrate of oxide of amyl and chloride of ammonium are obtained; no amylamide can be found in the products. By causing hyponitric acid to act on essence of gaultheria, nitro- and binitrosalicylate of oxide of methyl are produced with a separation of oxide of nitrogen. Nitrosopiperidine and nitrosodiethylamine, obtained by MM. Th. Wertheim and A. Geuther, must be regarded as nitro bases. These compounds are kinds of amides of nitric acid, and are obtained by a loss of water in the corresponding nitrites.

Preparation of Carbonic Acid.—(*Revue Heb. de Chim.*)—Messrs. Rousseau and Piedbœuf propose to obtain carbonic acid from sulphate of lime (plaster of Paris), by heating in retorts, arranged and made as those in use at gas works, a mixture of the material alluded to and charcoal or coke. The decomposition which ensues is represented by $\text{SO}_3\text{CaO} + \text{C}_2 = \text{SCa} + 2\text{CO}_2$.

A Peculiarity concerning Anthracite.—(*Revue Heb. de Chim.*)—In the mountains near Aosta, Italy, an anthracite is found, which, on account of containing too much iron pyrites, has very little value as fuel. According to the observations of Deyces, this substance has antiseptic properties, and has been applied to kill insects and as a suitable manure to vineyards; he also observed that, when given to pigs, at a dose of 20 grammes daily, it greatly assists the fattening of them.

Analysis of the Slime and Mud of the River Nile. by M. A. Houzeau. —(*Comptes Rendus*.)—One hundred parts of air-dried mud contain:—Water, driven off at 110°C , 77.70; clay and sand, 62.71; oxide of iron, magnesia, and small quantity of phosphate of iron, 14.70; carbonates of lime and iron, 0.57; alumina, 8.27; sulphate of lime, 0.56; organic matter and loss, 5.49; nitrogen in 100 parts, 0.0504. The author has also determined the composition of the water of the Nile during its periodical flood, and has paid special attention to the quantity of nitric acid and ammonia; among the curiosities of the results is, that the Nile carries every

week into the Mediterranean a quantity of 6,000,000 of kilogrammes of ammonia.

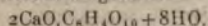
Fluorine in the Brain.—Professor Horsford, of Harvard College, has tried to detect fluorine in the human brain, he was induced to do so by the fact that fluorine so frequently accompanies phosphoric acid in the mineral kingdom, and also on account of the large proportion of phosphoric acid found in the brain and nerves by Von Bibra and others. After having very carefully ascertained that the reagents he was about to apply were quite free from fluorine, the learned professor operated upon a human brain which had been long kept in spirits of wine, but which in consequence of neglect had, by the evaporation of the liquor, become wrinkled up and dry. A series of carefully made experiments proved undoubtedly the existence of fluorine in the brain.

New Series of Platinum Compounds.—(*Poggendorff's Annalen*, vol. 136, part i., 1869.)—R. Schneider has discovered a new series of crystallisable platinum compounds, wherein stannous oxide and stannic acid play an important part. He first describes a compound containing 29.10 per cent platinum, 57.05 per cent tin, 13.85 per cent oxygen. This is called by him stannate of stannous protoxide of platinum. On treating this compound in the moist state with an aqueous solution of an alkali, soda for instance, he obtains a compound containing in 100 parts—Platinum, 50.0; tin, 29.3; sodium, 6.0; oxygen, 13.5; this is $\text{NaPtSn}_2\text{O}_6$, or stannate of protoxide of platinum and soda. The author further describes at very great length kalium platin-oxy-sulpho-platino-stannate, that is to say a compound containing in 100 parts Pt, 59.47, Sn, 11.86, K, 7.76, S, 19.35, O, 1.79, and also natrium platin-oxy-sulpho-platino-stannate, composed in 100 parts of Pt, 61.41, Sn, 12.02, Na, 4.73, S, 19.66, O, 1.80.

Reduction of Oxides by Hydrogen.—(*Poggendorff's Annalen*, vol. 136, part i., 1869.)—M. W. Müller has instituted a series of experiments with the view to determine precisely the temperature at which the oxides of metals begin to be reduced by hydrogen gas. He has experimented with oxides of various metals prepared in various ways, and also determined the effect of other gases, nitrogen, and aqueous vapour, upon the temperature of incipient reduction. Oxide of iron prepared by cautiously heating metallic iron in contact with air was found to get reduced at 285°C .; the same oxide prepared from nitrate of iron was reduced at 286° ; when rather moist hydrogen was applied and the oxide of iron prepared from oxalate of the protoxide, the temperature of reduction was found to be 278° . Oxide of copper prepared from the sulphate of that metal and precipitated by caustic soda, and previously heated to 300° , was found to become reduced at 135° ; strongly ignited oxide of copper became reduced at 142° on an average of five experiments; oxide of cobalt becomes reduced at about 132° ; oxide of zinc could not be reduced at a temperature whereby glass became fused; oxide of tin, about 174° ; oxide of lead, at from 310° to 315° ; peroxide of mercury, 230° ; oxide of silver, at between 73° and 78° . The experiments have been extended to the chlorides and sulphides of some metals. Chloride of gold does not appear to be acted upon below 200° , but at a higher temperature an explosion took place. The action with chloride of platinum was rather strong at 85° , and rather violent at 165° ; reduction of the metal took place. The chlorides of silver and lead are not reduced below the boiling point of mercury, but require a red heat; sulphide of gold is reduced at 200° , while sulphide of platinum is reduced at the ordinary temperature, sulphuretted hydrogen gas being formed in both cases.

Quantitative Estimation of Tartaric Acid.—(*Pharm. Zeitschr. f. Russ.*, 1869, No. 1.)—Dr. Martenson, First Assistant in the Chemical Laboratory of the Pharmaceutical Institute of Dorpat, Russia, has made a series of experiments, with the view to obtain a trustworthy and readily executed method of quantitative estimation of tartaric acid. After first ascertaining by a series of experiments that

tartrate of lime is less soluble in water than is commonly reported in books (he ascertained that 1 part of the aforesaid salt requires at 18° C. 2388.26 parts of water for complete solution), he discovered the almost complete insolubility of the tartrate of lime in alcohol of 85 per cent strength. In order to estimate the tartaric acid in tartrate of potash, for instance, the salt is dried at 100° C., dissolved in a small quantity of distilled water, next pure chloride of calcium solution is added, with the precaution to avoid excess thereof, afterwards a few drops of lime-water are added, and the porcelain capsule wherein this operation is performed is left standing for some hours. A crystalline precipitate is thus obtained; it is collected on a filter previously dried at 100° and weighed; the supernatant fluid is first poured upon the filter, then the precipitate is collected and washed with strong alcohol, the precipitate and filter are thoroughly dried at 100°, the precipitate is weighed as—



It is of importance to take care to use a porcelain basin the glaze of which is quite free from cracks, otherwise the precipitate has a strong tendency to adhere to such portions of the basin. When either hydrochloric or nitric acids are present along with tartaric, the fluid is first nearly neutralised with pure carbonate of lime, and warmed to expel carbonic acid, while the last traces of acid are removed with lime-water. The presence of either chloride of ammonium or chloride of calcium in excess interferes with the correctness of the results and makes it necessary to add alcohol to the liquid to be operated upon. Results are accurate when proper care is taken.

Detection of Sulphur by means of Potassium or Sodium.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Dr. Schön, at Stettin, recommends the use of either of these two metals for ascertaining the presence of sulphur in oxidised or non-oxidised state in inorganic compounds; a small quantity of the substance to be tested for sulphur is pulverised and placed in a dry test tube, a small piece of potassium or sodium is then added, and upon it a small quantity of the powdered substance which is to be tested is again placed in the test tube; heat is applied, reduction takes place, and sulphide of the metal is formed. The test tube, after cooling, having been broken, its contents are placed in a small quantity of water rendered acid by a few drops of sulphuric acid; sulphuretted hydrogen is evolved. If the quantity of sulphide formed is likely to be very small, nitroprusside of sodium should be used as a test. Care should be taken that only small quantities of substance are operated upon in this manner, especially since substances as realgar, orpiment, and others containing sulphur and arsenic, at the same time, violently explode and detonate when ignited with the above-named metals.

For Detecting Sulphur in Organic Substances, especially of Animal Origin.—(*Zeitschr. f. Anal. Chem.*, 1869.)—The same process is available. Hair and feathers, and dry skin and nails, may be at once submitted to ignition with the metal. White of egg, emulsin, saliva, and muscle, should first be calcined on a piece of platinum, and the animal charcoal so obtained be ignited along with potassium or sodium. In most cases of this kind, nitroprusside of sodium will be required to make the presence of sulphur absolutely evident.

Detection of Phosphorus by means of Magnesium.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Dr. Schön, at Stettin, found that when previously well-dried (previous ignition is often required) inorganic combinations of phosphorus and phosphates, even if they are mixed with sulphates, are ignited in pulverised state in a test tube with small quantities, say from 5 milligrammes to 1.5 centigrammes of magnesium wire, ribbon, or better still, pure magnesium in powder, there is formed phosphide of magnesium. After cooling, the fused mass, on being moistened with water, will disengage phosphuretted hydrogen gas, which, in many instances, will be found to be the spontaneously

inflammable variety of that compound. Phosphorus may be detected in the same way in organic substances; as, for instance, brains, muscle, &c.; but these should be previously calcined, and the dry animal charcoal so obtained submitted to the experiment.

Detection of Ozone in the Atmosphere.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Dr. Van Huizinga has made a series of experiments to compare the relative value of mixed iodide of potassium and starch, and of protoxide of thallium, for the detection of ozone in the atmosphere. He comes to the conclusion that neither of these two reagents are quite so reliable in all respects as is desirable, but the latter deserves preference. A series of comparative experiments were made by the author and Dr. Van Ster; the former being on the island of Texel, the latter at the Helder, and experimenting with paper prepared with iodide of potassium and starch. The thallium paper was impregnated with a preparation obtained by precipitating the sulphate of thallium with baryta water. The paper contained, for every square centimetre surface, about 1 milligramme of protoxide. It is well known that protoxide of thallium is changed by ozone into the brown oxide of that metal.

Detection of Picrotoxin in Beer.—(*Zeitschr. f. Anal. Chem.*)—Köhler's method for the detection of picrotoxin, the active and poisonous principle of *cocculus indicus*, is based upon the fact, that when ammonia is present, acetate of lead precipitates as insoluble matter from beer, such substances as dextrin, gum, glucose, while the picrotoxin, which is not thus precipitable, can be removed by means of ether from an acidified fluid. The beer to be tested is first mixed with ammonia until it is distinctly alkaline, the ensuing precipitate of phosphates is allowed to settle, and after the fluid has become clear, a boiling hot and concentrated solution of acetate of lead is cautiously added as long as a precipitate ensues; excess of lead solution should be avoided. The precipitate so obtained should be collected on a filter and washed with hot alcohol for a short time; from the filtrate, the lead is removed by means of sulphuretted hydrogen gas, the sulphide of lead removed by filtration, and the filtrate evaporated on a water-bath to the consistence of a syrup; the fluid obtained is treated with ether, the latter separated from the aqueous residue, and the ether removed by evaporation. Picrotoxin reduces the oxide of copper to protoxide, is soluble in sulphuric acid, exhibiting a saffron yellow coloured fluid. When bichromate of potash is added to the sulphuric acid solution, a violet colouration ensues, which ends by becoming bright green. If the beer contains strychnia simultaneously with picrotoxin, or extract of *cocculus indicus*, the strychnia remains behind in the syrupy fluid which remains after the ether is separated therefrom by means of a stoppered funnel.

Molybdic Acid a Test for Morphia.—(*Zeitschr. f. Anal. Chem.*, 1869.)—M. Almén has thoroughly tested the value of Fröhde's test for morphia—sulphuric acid which is contaminated with, or contains molybdic acid, purposely added. A beautiful purple tint is produced when such acid is brought into contact with either pure morphia or its salts.

Solubility of Silico-fluoride of Potassium in Dilute Hydrochloric Acid.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Since hydro-fluosilicic acid is sometimes resorted to in the quantitative estimation of potash, it should be borne in mind that, even though alcohol be used to increase the insolubility of the silico-fluoride of potassium, F. Von Stolber has observed that 1 part of this salt is dissolved by 400 parts of weak hydrochloric acid, containing 1.8 per cent real acid; while the stronger the acid becomes, the greater also the solubility, even at a temperature of 14° C.

Ebullition of Water.—(*Poggendorff's Annalen.*)—In reference to the well-established fact that water, after having been deprived of air as much as possible, either does not boil at all when heated, or does so with violent sudden starts and concussions, some experiments have been made by Kremers, who observed that, in order to assist in expelling

air from water, the addition of spirit of wine, in the proportion of one part of the latter to three of the former, is very useful. He cautions against a danger which exists when such a mixture is heated too rapidly, since it is very apt to boil over, especially after a portion of the spirit has evaporated. It is rather curious that, though both the water and spirit of wine employed were pure, the mixture, when boiling, should assume a greenish yellow hue, which disappears again on cooling; the boiling point of the fluid easily becomes as high as 109° . As a result of a large number of experiments, the author finds that water, as fully deprived of air as possible, may be heated as high as from 180° to 200° C., without boiling permanently.

Elementary Organic Analysis.—(*Zeitschr. f. Anal. Chem.*)—Messrs. Stern and Calberla recommend the use of pure metallic silver instead of copper-turnings in the elementary organic analysis when, nitrogen being present in the substance submitted to combustion, pure, clean metallic copper-turnings are, as is well known, placed in the front end of the combustion tube in order to reduce any binoxide of nitrogen which may be formed. The authors prefer silver on account of the non-necessity for reducing this metal again by means of hydrogen after the combustion is ended. Silver, according to their researches, answers all the purposes of copper admirably well.

Testing Opium.—(*Zeitschr. f. Anal. Chem.*)—Professor Schneider has proposed in the 6th revised edition of the *Pharmacopœia Austriaca*, the following method for testing the goodness of opium. Ten grammes of previously dried and powdered opium is treated with a mixture of 150 grammes of distilled water, to which 20 grammes of pure hydrochloric acid, sp. gr. 1.12, is added; the residue, after extraction, should not exceed 4.75 grammes weight; to the acid fluid 20 grammes of common salt are added, and the precipitate thereby caused is collected, after 24 hours, on a filter, and the latter washed with a solution of common salt; to the filtrate, ammonia is added, and the fluid left standing again for 24 hours; the crystals which have separated are collected, re-dissolved in acetic acid, and precipitated with ammonia; the precipitate so obtained is washed, dried, and weighed; its weight should not be less than 1 gramme.

Toluol.—(*Comptes Rendus*, 1869, No. 10.)—M. A. Rosenstiehl has made a series of experiments with the view to solve the question whether the toluol we are acquainted with is a mixture of two isomeric hydrocarbons, which should yield two toluidines, or whether toluol is a peculiar principle which on being acted upon by nitric acid is converted into two different nitro-compounds. From seven samples of toluol prepared by as many different processes, the author has obtained the same result, to wit, a crystallised nitro-toluol, corresponding to toluidine, and another liquid—nitro-toluol—corresponding to the pseudo-toluidine. By the reduction of divers nitro-toluids, prepared by various methods, the author obtained a large quantity of alkaloids which have been submitted to analysis; he found also (1) there are always two nitro-toluids formed, which, by reduction, yield two toluidines; (2) the proportion of the two nitro-substances is not constantly the same; he never obtained more than 66 per cent and never less than 33 per cent of toluidine from 100 parts of crystallised nitro-toluol.

Artificial Sulphate of Baryta.—(*Boston Journal of Chemistry*.)—This, applied to glass by means of silicate of potash, imparts to it a milk-white colour of great beauty; in a few days the silica is intimately combined with it, and the colour resists washing with warm water. By the action of strong heat, this siliceous varnish is transformed into a white enamel. Blue ultramarine, oxide of chromium, and pulverised coloured enamels may be likewise applied.

Estimation of Carbonates in Water.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Chevalet estimates the entire quantity of carbonates in water by taking 200 c.c., filtering that quantity, and, after adding to it 0.5 gramme of chloride of ammonium, distilling, taking care to collect the first 100 c.c. which

come over in 10 c.c. of very dilute sulphuric acid. He next estimates, acidimetrically, the sulphuric acid which has not become combined with ammonia. According to this method he found the solubility of carbonate of lime to be 0.034 gramme, and that of carbonate of magnesia to be 0.106 gramme to the litre of water. These results agree with those obtained by Dr. Hofmann and M. C. Weltzien.

Action of Saline Solutions upon Minerals.—(*Zeitschr. f. Anal. Chem.*, 1869.)—In order to find methods of immediate analysis, Mr. Fevreil has studied the simultaneous action, especially of ammoniacal salts and heat, upon a series of native carbonates. Those of baryta, strontia, and lime are readily and completely acted upon, especially if the acid of the ammoniacal salt experimented with forms in water a readily soluble combination with the carbonate. Native carbonate of magnesia is readily acted upon by all ammoniacal salts; so is also the native carbonate of protoxide of manganese; although less readily, still very unmistakably, carbonate of protoxide of iron is acted upon; with the native carbonates of zinc, lead, and copper, the same was observed.

Atomic Weight of Lanthanum.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Since the determination of the atomic weight of this element has only been derived from the sulphate of baryta obtained from sulphate of lanthanum, and since it has been found that this method is incorrect, in consequence of there being carried down, with the sulphate of baryta, undecomposed sulphate of lanthanum, Dr. W. Casselmann has estimated the correct quantity of sulphuric acid which combines with oxide of lanthanum, by means of ignition. From a long series of several experiments, which agreed, he has deducted the atomic weight of lanthanum to be 45, and that of its oxide 53.

Testing Cinchona Bark.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Twenty grammes of quina regia, or rubra, and 50 grammes of quina fusca are reduced to powder and intimately mixed with one-fourth of their weight of hydrate of lime; this mixture is next placed in ten times its weight of boiling alcohol of 90 per cent strength, filtered, and the residue washed with boiling alcohol. The alcoholic solution is acidified with acetic acid, next the alcohol is removed by distillation, the residue evaporated to dryness on a water-bath, re-dissolved in water containing acetic acid, again filtered, again evaporated to a small bulk, and treated with hydrate of lime. The ensuing precipitate is washed with a small quantity of water, the residue dried, next treated with boiling alcohol, this solution again evaporated to dryness, and the residue weighed. The weight to be obtained from the above-named quantities should not be less, for quina rubra, than $\frac{1}{2}$ of a gramme, for quina regia and fusca not less than $\frac{1}{4}$ a gramme, provided the barks be of good quality and the operations conducted with proper care.

Action of Air upon Hypophosphorous Acid.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—According to the late G. Rose's views, hypophosphorous acid does not absorb the oxygen from the air, while, according to Würtz, hypophosphites are slowly converted into phosphites. Dr. C. Rammelsberg, in order to settle this point, neutralised some hypophosphorous acid which had been for a long time exposed to air, with carbonate of lime; on testing the salt he thus obtained, he found it gave reactions due to phosphorous acid—consequently hypophosphorous acid changes, by the action of air, into phosphorous acid.

On the Composition of Hydrated Sulphide of Zinc.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—It appears, from different researches, that the hydrated sulphide of zinc does not always possess the same physical properties, and also varies in respect of the water it retains, even after drying. According to recent researches made by M. A. Souhay, the sulphide obtained by precipitating a solution of sulphate of zinc with sulphide of ammonium retains, even after having been kept for several months over sulphuric acid, 11.37 per cent of water, which corresponds to the formula $3ZnS, 2H_2O$; dried at 100° C., it retains 7.35 per cent of water, corresponding approximately with the formula $2ZnS,$

HO; dried at 150°C ., it retains 4.86 per cent of water—formula, $5\text{ZnS}_2\text{HO}$.

Preparation of Spongy Oxide of Chromium.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to set fire to a mixture of 1 part of picric acid and 2 parts of bichromate of ammonia.

Preparation of Perfectly Pure Oxygen Gas.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to heat permanganate of potash; it is true that this salt only yields about 10 per cent of oxygen, but it is perfectly free from chlorine, as well as from ozone. There remains, as residue, a mixture of manganate of potash and oxide of manganese, readily re-convertible into permanganate.

Action of Heat on Sulphate of Strontia.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. Darmstadt calls attention to the fact that sulphate of strontia obtained by double decomposition loses sulphuric acid when it is strongly ignited; moistened again with dilute sulphuric acid, it regains its primitive weight after ignition over a Bunsen burner. Boussingault proved years ago that all the sulphates of the alkaline earths lose sulphuric acid when strongly ignited.

On the Preparation of Zinc-Ethyl.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. H. Wichelhaus has found that the coarsely powdered zinc, obtained by passing zinc filings through a sieve, acts directly upon the iodide of ethyl, without the necessity of having the zinc alloyed with sodium. The reaction readily takes place when the apparatus containing the mixture is placed in a water-bath; the apparatus should be provided with a tube containing mercury, in order to increase the pressure; the reaction is finished in two or three hours. The result is satisfactory, and yields from 80 to 90 per cent of the theoretically required quantity.

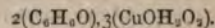
Composition of Sugar-Scum.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—This material, which is used as manure, is obtained in that portion of the sugar refining and sugar extraction process called *defecation*. The results of the analysis here quoted are given by M. Roussille:—Organic matter, 33.51; carbonic acid, 10.37; silica and soluble silicates, 3.42; soluble silica, 0.90; oxide of iron and alumina, 1.37; phosphoric acid, 0.46; lime, 41.40; potassa and soda, 0.04; chlorine, 0.02; sulphuric acid, 0.03; water, 7.27; loss, 1.21; total, 100.00; nitrogen, 0.46. It is almost unnecessary to observe that the composition of this material will of necessity vary in many aspects.

Researches Concerning Balsamic Modena Vinegar.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Fausto Sestini has made some researches concerning this substance, very little, if at all known, or used, in more recent times; all the samples, five in number, submitted to analysis were more than 100 years old. The fluids are dark coloured, exhibit an aromatic odour, possess a pleasant acid taste, are rather thickish, syrup-like, but miscible with water without becoming turbid; mixed with alcohol, however, a dark-coloured precipitate ensues. The specific gravity of these fluids varied from 1.1931 to 1.3177; the quantity of water from 42.647 to 62.270 per cent; the quantity of mono-hydrated acetic acid from 7.051 to 10.011 per cent; fixed acid was present at from 0.767 to 1.925 per cent; ulmin-like matter was found at from 2.072 to 5.531; other fixed non-volatile organic matter occurred at from 18.464 to 44.447 per cent; ash, at from 0.952 to 1.290 per cent. It is rather curious, that, among the substances found by the author in these fluids, glucic and apogluic acids have been met with.

Readily Inflammable Liquid Mixture.—(*Cosmos*, April 10, 1869.)—Professor Nicklès calls attention to the facts that when the chloride of sulphur of commerce is mixed with sulphide of carbon, wherein phosphorus has been previously dissolved, a fluid is formed, which, though emitting fumes when in contact with air, is harmless, and may be for any

length of time kept in well-stoppered bottles; on addition of liquid ammonia, however, or on passing into this liquid a few bubbles of ammonia gas, a most intense combustion at once ensues. This is due to the fact that the ammonia seizes upon the chloride of sulphur, forming chloride of ammonium, whereby so much heat is set free as to cause the combustion of the sulphide of carbon and phosphorus dissolved in it.

On Some Molecular Combinations of Phenol.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Professor J. Romei has repeated some experiments suggested to his mind by some made by Dr. C. Calvert on this same subject, in order to test whether Gerhardt's view of phenol, or that of the former gentleman, were correct; the question being whether the combinations of phenol with bases are true salts, or simply molecular juxtapositions of matter. Professor Romei has concluded, from his experiments, that Dr. Calvert's view is correct—that is to say, that the combinations of phenol with bases is a simple molecular juxtaposition, and not an atomic compound. Phenate of potassa may be made either by mixing together alcoholic solutions of phenol and hydrate of potassa, and evaporating until crystals are formed, or by fusing together phenol and potassa; in both instances a crystalline mass is obtained which absorbs moisture from the air, becomes gradually yellow and lastly brown, is soluble in water and alcohol, somewhat soluble in ether containing water, but almost entirely insoluble in anhydrous ether. As average result of four analyses, the following figures were obtained for 100 parts:—Phenol, 56.60; hydrated potassa, 31.30; water, 12.00—this is represented by the formula, $\text{C}_6\text{H}_5\text{O}, \text{KHO}$. Phenate of oxide of copper is obtained by double decomposition, by pouring a solution of sulphate of copper into a solution of phenate of potassa. The phenate thus obtained is dried over sulphuric acid; it is a green powder, soluble in acids and readily decomposed by heat; its composition is exhibited by—

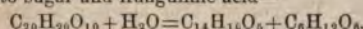


It contains 55.88 per cent of oxide of copper; the water of combination cannot be removed by heat, or otherwise, without decomposing the salt. Phenate of oxide of mercury, also obtained by double decomposition and drying over sulphuric acid, yields a compound containing 69.33 per cent of oxide of mercury—formula, $\text{C}_6\text{H}_5\text{O}, \text{HgO}_2\text{H}_2$. Phenate of quinine is prepared, by double decomposition, from 8.72 parts of sulphate of quinine and 3 parts of phenate of potassa, both in alcoholic solution. After twenty-four hours' standing, the sulphate of potassa is removed by filtration, and the filtrate evaporated at a very gentle heat; very beautiful crystals are obtained nearly insoluble in ether, very soluble in alcohol and acids, but insoluble in water. On analysis, this substance yielded 76.69 per cent of quinine, while the theory requires 77.51. The author calls attention to the fact that phenate of potassa may very usefully serve for the detection of water in ether; the salt is entirely insoluble in pure anhydrous ether, but as soon as any water is present therein, partial solution takes place, even if the ether contained only 2.50 parts of water in 1000 of ether.

On Cinnamate of Benzyl.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—From Peru balsam Frémy has obtained an oily substance named cinnameine; this material yields, when saponified, cinnamic acid. When chloride of benzyl and thoroughly dry cinnamate of soda are mixed and boiled along with alcohol, cinnamate of benzyl is formed; this substance, represented by $\text{C}_{15}\text{H}_{11}\text{O}_2$, is obtained in small pearly, scaly crystals. It melts at 39°C ., and may remain in a semi-fluid state, even at a temperature close upon 0°C .; it distils over, unchanged, in a space from which air is exhausted at between 225° and 235° ; becomes decomposed at 350° , yielding cinnamic acid and oily substances. It is very soluble in alcohol and ether; when deposited after the evaporation of that solvent, it exhibits oily drops, which slowly solidify. It is decomposed by an alcoholic solution of potassa.

On the Cause of the Hardening of Hydraulic Cement.—(*Zeitschr. f. Chem.*)—In order to test the truth of the different hypotheses made concerning to this subject, A. Schultschenko, seeing the impossibility of separating, from a mixture of silicates, each special combination thereof, repeated Fuchs's experiment, by separating the silica from 100 parts of pure soluble silicate of potassa, and, after mixing it with fifty parts of lime, and placing the mass under water, when it hardened rapidly. A similar mixture was submitted to a very high temperature, and in this case, also, a cement was made. As a third experiment, a similar mixture was heated till it was fused; after having been cooled and pulverised, the fused mass did not harden any more under water. Hence it follows that hardening does take place in cement made by the wet as well as dry process, and that the so-called over-burned cement is inactive, in consequence of its particles having suffered a physical change.

Frangulin.—(*Zeitschr. f. Chem.* 1869, No. 1.)—The substance which, many years ago, was named rhamnolanin by Buchner, is obtained from the bark of the *Rhamnus frangula*, a tree growing wild in Southern Europe, by boiling it with ammoniacal water, precipitating with hydrochloric acid, and boiling the precipitate with alcohol and acetate of lead. Frangulin, $C_{20}H_{20}O_{10}$, exhibits a yellow mass having a distinctly crystalline texture, as may be seen with a lens, almost insoluble in cold water, slightly soluble in cold alcohol, and more soluble in boiling alcohol, soluble in alkaline solutions, and then exhibiting a most brilliant purplish-red colour. Its ammonia solution is at first colourless, and becomes, after a while, a brilliant red; it fuses at $226^{\circ}C$, and is a very weak acid. Acids split this substance into sugar and frangulinic acid—



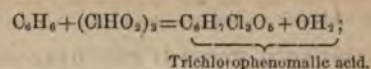
Detection of Sulphurous and Hyposulphurous Acid.—(*Zeitschr. f. Chem.*, 1869, No. 1.)—Instead of employing hydrochloric acid and zinc, Reichardt uses aluminium and hydrochloric acid. Zinc may be contaminated with sulphur compounds, while aluminium, on account of its having almost no affinity for sulphur, is always pure in this respect; the latter metal, moreover, dissolves very slowly in dilute hydrochloric acid, and therefore the same piece of aluminium may serve for many testings. Reichardt distinctly detected the sulphuretted hydrogen when a solution of one part of SO_2 in water, diluted with 500,000 parts of water, was treated with HCl and aluminium.

On Pyruvic Acid.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—MM. Ph. de Clermont and R. Silva state that they have been engaged for some time in researches on this acid, but that the results obtained are not sufficiently far advanced to enable them to speak with exactitude as to its real composition. Purified pyruvic acid, treated by bromine, becomes a crystalline mass, which was found to be bibromolactic acid; this acid, treated with water and evaporated in vacuo, yields a crystalline mass—another acid—the nature of which has not yet been further investigated.

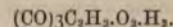
Observations on the Preparation of Strong Hydriodic Acid in Solution.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—Since this acid is becoming daily more and more used, Mr. Ferd. Vigier has studied the best mode of its preparation. It is well known that, for this purpose, a mixture of amorphous phosphorus (as first suggested by M. Personne), iodine, and water is gently heated in a tubulated retort to the neck of which a glass tube has been soldered. Vigier has found that too often, in text and hand-books on Chemistry, a wrong proportion of the ingredients to be used is given; and after some experiments on this subject, he finds that 1 part of phosphorus, 20 parts of iodine, and 15 of water, are the best and only proper to ensure the reaction taking place; these proportions correspond to the formula, $P + 5I + 5HO = PO_5 + 5HI$.

Constitution of Phenacetic Acid, and the Transformation of Benzol into Tartaric Acid.—By L. Carrius.—(*Ann. d. Chem. u. Pharm.*, vol. clx., No. 3, March,

1869.)—In a former paper, the author described two substances—trichlorophenacetic acid and phenacetic acid; the former of these is the direct product of the action of hydrate of chloric acid upon benzol, according to the formula—

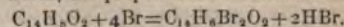


the latter combination, however, is the result of the action of metallic oxides upon the acid just alluded to. Phenacetic acid is a tribasic acid, which may be considered as tricarboxylic acid—

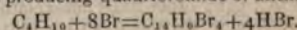


The author describes at great length a series of very complex combinations and reactions obtained by him while studying this acid and submitting it to divers chemical agents, and finally arrives at the result that tartaric acid may be obtained from phenacetic acid, and hence, derivatively, from benzol by the intermediate of dibromo-succinic acid.

Synthesis of Alizarine.—(*Moniteur Scientifique*, No. 296, April 15th, 1869.)—For a number of years past many scientific chemists have tried to obtain alizarine by artificial means. In the year 1861, M. Roussin thought he had succeeded, by withdrawing from binitronaphthalene, $C_{10}H_8$ (NO_2), two equivalents of oxygen, and by converting at the same time the nitrogen into ammonia. Although this experiment was unsuccessful, it has no doubt been made the starting point for the very important solution of this problem, which MM. Graebe and Liebermann, at Berlin, have just brought to a highly successful issue. The two last-named gentlemen found that when alizarine obtained from madder-root was acted upon by powdered zinc, a hydrocarbon was generated, which, instead of naphthalene, proved to be paranaphthalene, which, according to the researches of MM. Anderson, Fritzsche, Limpricht, and Berthelot, has the following formula:— $C_{14}H_{10}$; accordingly, MM. Graebe and Liebermann consider that the formula for alizarine should be $C_{14}H_8O_4$. It will be observed that this formula differs from that of paranaphthalene only by having two atoms, four equivalents of oxygen more, and two of hydrogen less, than that of paranaphthalene. The process of transformation of paranaphthalene into alizarine consists of three operations:—First, the paranaphthalene, also named anthracene, $C_{14}H_{10}$, is converted into anthraquinone, $C_{14}H_8O_2$, which is done by either heating one part of anthracene with two parts of bichromate of potassa and sulphuric acid, or by heating the anthracene with bichromate of potassa and anhydrous acetic acid; the anthraquinone thus obtained is first washed with water crystallised from alcohol or benzol, and so purified constitutes a yellow-coloured solid, crystallising in needles. The second portion of the process consists in substituting, for two atoms of hydrogen, two of bromine in the anthraquinone—in other words, the preparation of bibromanthraquinone—



Two methods may be followed for this operation—either by heating, without simultaneously applying pressure, the anthraquinone with bromine, at temperatures varying between 80 to $130^{\circ}C$; or, without first preparing anthraquinone, by making the bromine act directly upon the anthracene, thus producing quadribromide of anthracene—

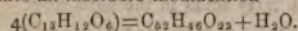


The quadribromide (first discovered by Anderson) thus produced is next oxidised by any of the two methods above described, and then bibromanthraquinone is obtained; if preferred, chlorine may be substituted for bromine. The third part of the process is the conversion of the bibromanthraquinone into alizarine; for this purpose it is heated, at from 130° to $260^{\circ}C$, with a solution of caustic potassa or soda; a blue colour is produced, which becomes more and more deep at first; when the deepening of the colour ceases, the operation is finished. After cooling, the saline mass is treated

with water, the solutions are filtered, an acid is added in excess, and a yellow precipitate ensues, which is the alizarine, or lizaric acid; this, after washing with water and gently drying, is fit for use, and is in all respects identical with that naturally produced in the madder root.

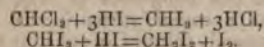
On the Substitution of Graphite by Antimony in Galvanic Batteries.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2).—According to Böttger, the following arrangement is preferable, as regards force and durability, to either Daniell, Minotto, or Leclanche's batteries. A cylinder of amalgamated zinc is placed in a concentrated solution of equal parts of common salt and sulphate of magnesia; the antimony is placed in a porous cell filled with dilute sulphuric acid.

Abietite (*Les Mondes*) is a substance discovered by Rochleder in the needle-like leaves of the *Abies pectinata*; in many aspects it resembles mannite, from which it differs by its solubility and composition, which may be represented by $C_{12}H_{12}O_5$. The said leaves also contain a soluble tannin, $C_{12}H_{12}O_6$, which, by losing oxygen and hydrogen, is readily transformed into an insoluble modification—



Action of Hydriodic Acid on Organic Chlorides.

—(*Les Mondes*).—According to A. Lieben, the chlorides of ethyl, butyl, and amyl, and also other chlorinated organic compounds, when heated in sealed tubes with hydriodic acid, are converted into the corresponding iodides without any disengagement of gas. In order to discover whether, perhaps, there were actions of mass in play, the author has reversed the experiment, by treating iodide of ethyl at 130° C. in a sealed tube with hydrochloric acid; there was only a slight trace of chloride of ethyl formed. When chloroform is heated for seven hours consecutively with eleven times its weight of hydriodic acid at 127° in a sealed tube, there is formed hydro-iodoform, iodide of methylene, hydrochloric acid, and free iodine; this reaction may be thus represented:—



Some Varieties of Roccella Tinctoria.—J. Stenhouse.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—The most interesting portion of this rather long paper is undoubtedly an improved method for the estimation of the quantity of colouring matter contained in these and similar kinds of lichens. For this purpose, 100 grains of the lichens are to be digested with a dilute solution of caustic soda; this operation should be repeated, in order to make sure of extracting all useful matter. The fluid so obtained is filtered; after filtration it is treated with a solution of hypochlorite of soda of known strength, the addition of which solution produces a blood-red colouration of the fluid, and this continues as long as any colouring matter is left. From the quantity of *eau de javelle* used the quantity of colouring matter may be inferred.

Kyaphenin.—By C. Engler.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—When treating benzo-nitrile with bromine, the author obtained a substance which proved to be identical with that obtained by Cloez on treating chlorobenzoyl with cyanate of potassa. Cloez considers kyaphenin as tri-benzo-nitrile, in consequence of its analogy with kyanaethin. M. Engler has tried in vain to obtain salts of kyaphenin; he states that, unlike Cloez, he did not find ammonia abundantly given off, if kyaphenin were boiled even in sealed tubes at 150° C. with an alcoholic solution of caustic potassa. On treating the kyaphenin in a sealed tube at 220° with excess of fuming hydriodic acid, benzoic acid was formed, besides some iodide of ammonium and a small quantity of an oil, probably hexyl-hydrogen.

On the Existence of a Normal Propyllic Alcohol.—By R. Fittig.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—The discovery by Chancel of a normal propyllic alcohol in fusel oil has been frequently disputed and

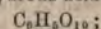
contradicted. M. R. Fittig obtained from Dr. Marquard's well-known chemical works, near Bonn, a product which purported to be propyllic alcohol, and which, notwithstanding its greater bulk, was made up of different alcohols, containing, on the whole, a very fair proportion of propyllic. Instead of trying to separate these alcohols by a fractional distillation, which never yields satisfactory results, the author converted the whole of the raw material, by means of amorphous phosphorus and bromine, into bromides and after purifying these, he separated them from each other by means of fractional distillation. He obtained a fluid boiling at 71° C., and on submitting it to elementary analysis, obtained from the fluid and its silver salt results which place the existence of Chancel's normal propyl alcohol out of all question. The raw liquid obtained from Dr. Marquard, above alluded to, was found to contain about 10 per cent of propyllic alcohol.

Researches on Hungarian Wheat and Wheaten Flour.—By O. Dempwolff.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—It is a well known fact, that the composition of wheat varies according to climate and soil.

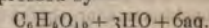
At Pesth is established a most extensive depot and granary for the produce of Hungary, and also a very large establishment for grinding wheat. The analysis of the grain gave the following result for 100 parts:—Water, 10.511; ash, 1.505; gluten, 14.352; starch, 65.407; fatty matter and woody fibre, 8.225; together 100.000. The existence of sugar could not be proved. The chief ingredients of the ash were found to be—phosphoric acid, 49.902 per cent; potassa, 31.825; magnesia, 14.862 per cent.

On Gummie Acid and some of its Combinations.

—M. Felsko.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—Gummie acid was first discovered by Reichardt, in 1863, and its name derived from the fact that this substance (the acid), accompanied by a gum-like matter, is formed when oxide of copper in alkaline solution is acting upon grape sugar. The anhydrous acid has the formula—



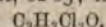
the hydrate is expressed by—



Neutral, or alkaline ammoniacal solutions of the acid are precipitated by chloride of calcium solution. Lime-water yields directly a precipitate. Chloride of iron does not precipitate the acid, or its salts, but does so on addition of alcohol; solutions of platinum and silver become reduced to metal when in contact with the acid. The acid combines with bases and oxides of metals to form salts.

On Bichloruretted Aldehyde.—M. Paterno.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869).—The

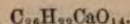
author has prepared this substance by distilling a mixture of bichloruretted acetal with from four to six parts, by bulk, of ordinary concentrated sulphuric acid. It is best to perform this operation in a retort, placed in an oil-bath and heated to about 130° C.; the receiver adapted to the retort is kept very cold, and the contents thereof are, after the end of the reaction, rectified. The fluid which comes over between 88° and 90° is the pure bichloruretted aldehyd; this liquid is heavier than water, and soluble therein, and likewise soluble in alcohol and ether; it boils between 88° and 90° , and its vapour strongly affects the eyes. Its elementary analysis yielded the following results:—Carbon, 21.23; hydrogen, 1.77; chlorine, 62.83; its formula is—



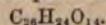
and the density of its vapour 3.9.

Phlobaphen.—(*Journ. f. Prakt. Chem. v. Erdmann*, 1868, Nos. 23 and 24).—Phlobaphen, an amorphous kind of tannic acid precipitable by acetate of lead, is, according to Grabowski, the principal constituent of the oak bark. When this phlobaphen is boiled with dilute sulphuric acid, it is split up into sugar and oak-red (eichenroth); this substance, purified as much as possible, and dried at 120° C., proved, on elementary analysis, to yield, in 100 parts—C, 55.4; H, 4.4.

Combined with calcium, the composition of this substance is expressed by—



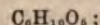
The oak phlobaphen is composed according to—



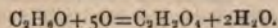
Isodulcite.—*Journ. f. Prakt. Chem. v. Erdmann, 1868, Nos. 23 and 24.*—Isodulcite is a sugar-like substance derived from quercitrin, by boiling it with dilute sulphuric acid. M. G. Malin has studied the isodulcitic acid obtained from isodulcite by oxidising it with nitric acid; the acid so obtained crystallises, is almost insoluble in alcohol, readily soluble in water, and it does not exercise a reducing action upon an alkaline solution of copper. After having been dried over strong sulphuric acid, the elementary analysis of this substance leads to the formula—



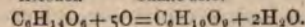
The isodulcitic acid is the most highly oxidised substance belonging to a series of compounds which begins with sugar of milk,



the acid alluded to originates from isodulcite, in the manner as oxalic acid is derived from alcohol—

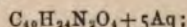


Alcohol. Oxalic acid.



Isodulcite. Isodulcitic acid.

Conchicine.—(*Journ. f. Prakt. Chem. v. Erdmann, 1868, Nos. 23 and 24.*)—The alkaloid belonging to and derived from the Cinchona-trees, known as chinidine, β chinidine, β chinine, B chinine, cinchotine, crystallised chinidine, and pitoyine, has been christened by Hesse conchicine, because it resembles chinine, as well as cinchonin. In order to prepare this conchicine, which occurs to upwards of 1.6 per cent in pitoya bark, the commercial chinidine is the best source, since therein the conchicine is largely found. The chinidine is repeatedly treated with eight times its weight of ether, this solution is filtered, and the ether removed by distillation; the residue is dissolved in dilute sulphuric acid, and afterwards carefully neutralised with ammonia. The solution is next treated with Seignette salt, whereby the tartrates of quinine and cinchonidine are precipitated, while the tartrates of cinchonine and conchicine remain in solution. After having treated the previously filtered solution with animal charcoal, iodide of potassium is added to the warm solution, whereby hydriodide of conchicine is precipitated as crystalline powder; this salt is decomposed by ammonia, re-dissolved in acetic acid, re-purified with animal charcoal, and, lastly, treated with hot alcohol, from which it separates in crystalline form. The conchicine so obtained is soluble in 2,000 parts of water at 15°, in from 35 to 22 parts of ether, according to temperature, and in 26 parts of 80 per cent alcohol; the substance melts at 168° C., without charring. The substance, which is capable of forming several hydrates, has for its formula—



it forms, with acids, salts.

Analysis of Ripe Grapes.—(*Journ. f. Prakt. Chem. v. Erdmann, No. 1, 1869.*)—Dr. Classen has done good service to science, as well as technology, by supplying us with these analyses; the grapes, three different kinds, grown in the neighbourhood of Kreuznach, were bought promiscuously in the market-place there:—1,000 grammes of fruit yielded—(1) 577, (2) 634, (3) 688 grammes, juice; this consisted in 10,000 parts of solid substance dried at 100° C.—(1) 1644, (2) 1897, (3) 2046; grape sugar—1499, 1624, 1740; free acid—72, 68, 48; ash—27.83, 30.95, 40.08. The ash contains, as might be expected, a large proportion of potassa and phosphoric acid as the chief constituents, and besides

chlorine, sulphuric acid, lime, silica, and small quantities of magnesia, and oxides of iron and manganese.

Notes on the Manufacture of Soap.—(*Journ. f. Prakt. Chem. v. Erdmann, No. 1, 1869.*)—It is a well-known fact that, by an indirect process, a potassa soap may be converted into a soda soap; this is done by adding to a boiling solution of potassa soap a very concentrated solution of common salt; and it is generally taken for granted that, if enough of the latter has been added, the potassa is converted at least chiefly into soda, while chloride of potassium is formed. Neither in chemical nor in technological works the question how much of the potassa is substituted by soda has been answered; hence it occurred to Dr. Oudemans to ascertain this point, he having a good opportunity to do this by being acquainted with the proprietors of large soap-works. Without entering into the full details of his published paper on the subject, we quote the results obtained by him, which are these:—By the process as executed on the large scale, and yielding excellent produce, only a little more than half, to wit 53.7 per cent, of potassa is replaced by soda, while 46.3 per cent of potassa are left along with the other alkali combined with fatty acids in the curd soap.

Analysis of the Celebrated Aventurin Glass made at Venice.—Dr. Salvetti. (*Pharm. Zeitschr. f. Russland, No. 2, 1869.*)—In 100 parts:—Silica, 67.3; alumina, 9.0; peroxide of iron, 3.4; oxide of tin, 2.3; oxide of lead, 1.0; metallic copper, 4.0; potassa, 5.3; soda, 7.0.

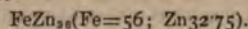
On the Solubility of Iodine and Sulphur in Petroleum.—Dr. Th. Koller. (*Neues Jahrb. f. Pharm., vol. xxxi, No. 2, 1869.*)—One part of iodine requires for its solution, at a temperature of 17° C., 145.6 parts of petroleum, and 1 part of sulphur (as so-called flowers sulphur), requires at the same temperature 158.4 parts of petroleum.

Curiously Petrified Wood.—(*Journ. f. Prakt. Chem. v. Erdmann, No. 1, 1869.*)—Dr. Oudemans, jun., has had the opportunity of analysing some pieces of wood from the *Colbertia ovata*, a tree indigenous to Java, which wood, on being placed in a certain stream in that island, becomes rapidly and thoroughly petrified, so as hardly to be distinguishable from sandstone; but microscopic research detects the organic structure. The air-dried wood leaves 1.9 per cent of ash of the following composition in 100 parts:—Silica, 58.8; phosphoric acid, 1.8; carbonic acid, 8.6; oxide of iron, 1.5; alumina, trace; oxide of manganese, 0.1; lime, 12.8; magnesia, 2.7; potassa, 11.3; soda, 1.8. The petrified wood was composed of—silica, 98.0; phosphoric acid, oxide of iron, and alumina, together, 1.3; lime, a trace; organic matter and water, 0.7. It is not quite possible to explain what causes this curious change, unless there were an opportunity to obtain and analyse the water, wherein the petrifying process goes on (as is said by the natives) very rapidly.

Analysis of Smalt.—(*Journ. f. Prakt. Chem. v. Erdmann, No. 1, 1869.*)—Under this name is known a blue pigment largely used on the Continent; the sample, of which the result of analysis is here quoted, was as beautiful as best artificial ultramarine. In 100 parts:—Silica, 63.7; oxide of lead, 2.7; protoxide of cobalt, 5.7; potassa, 20.1; alumina, 4.0; oxide of iron, 1.3; water, 1.7. Not a trace of protoxide of nickel was found.

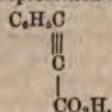
On an Alloy of Iron and Zinc.—(*Journ. f. Prakt. Chem. v. Erdmann, No. 1, 1869.*)—It is a well-known fact that iron is dissolved by molten zinc, but nowhere is any definite alloy of these metals described, nor is it also stated how much iron is dissolved by zinc. Dr. Oudemans, jun., obtained for analysis a piece of metal which had been formed in an iron vessel wherein zinc had been fused for several weeks continually; this metal was found deposited at the bottom of the vessel, and became an impediment to the melting operations in consequence of the relative infusibility of the alloy. In physical aspect this latter was of very much whiter colour, and entirely different crystalline structure than

zinc; the alloy dissolved very readily and briskly in dilute sulphuric or hydrochloric acid, and was found, on analysis, to contain 4.6 per cent of iron. Taking for granted that this alloy is a definite compound of the two constituent metals, its formula would be—

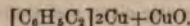


Analysis of Two Kinds of Labradorite.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Oudemans, jun., analysed two varieties of this mineral—one violet-coloured, the other white and non-transparent. Violet variety in 100 parts:—Silica, 56.21; alumina, 29.19; oxide of iron, 1.31; lime, 11.14; magnesia, 0.51; soda, 1.37; potassa, a trace; loss on ignition, a trace; total, 99.73. White variety in 100 parts:—Silica, 58.1; oxide of iron and alumina, 27.9; lime, 9.4; magnesia, a trace; soda, 5.1; total, 100.5.

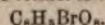
Researches on some Derivatives from Cinnamic Acid.—C. Glaser.—(*Zeitschr. f. Chem. v. Beilstein*, &c., vol. xii., No. 4, 1869.)—The author has, in a former notice, spoken of an acid containing H_2 less than cinnamic acid; that acid has been called by him phenylpropionic acid, the constitution of which is represented by—



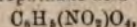
The author further states that, by taking CO_2 from this acid, he would be enabled to form a new hydrocarbon, which would stand in the same relation to acetylen as styrol stands to ethylen. This new hydrocarbon is named acetenylbenzol; this material is a colourless, highly refrangible fluid, having a peculiar odour, and boiling at 140° ; vapour density, 3.7; formula, C_8H_6 . It is readily decomposed by nitric and sulphuric acids. It combines with copper, forming a compound—



Bromophthalic and Nitrophthalic Acids.—Faust.—(*Zeitschr. f. Chem. v. Beilstein*, &c., vol. xii., No. 4, 1869.)—The author prepared, for some other researches, bromo and nitrophthalic acids. The former is represented by—

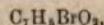


In the pure state it is a white crystalline powder readily soluble in water, alcohol, and ether, and fuses between 136° and 138°C ., without giving off vapour of water; it forms salts with bases. Nitrophthalic acid—

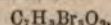


is obtained when phthalic acid is digested with a mixture of equal parts of red fuming nitric acid and sulphuric acid; the mixture is left for twenty-four hours to itself, and then treated with water and purified by making a potash salt of the newly formed acid, and this is decomposed by means of sulphuric acid. Nitrophthalic acid crystallises from ether in straw-yellow prisms, is soluble in water and ether, and fuses at 208°C . This acid also forms salts very readily.

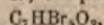
Mono-Tri- and Penta-bromo-benzoic Acid.—Reinecke.—(*Zeitschr. f. Chem. v. Beilstein*, &c., xii., No. 4, 1869.)—When bromine acts upon benzoic acid, water being present and a higher temperature applied, the above-named bromo-benzoic acids are obtained. The mono-bromic acid—



is difficultly soluble in water, crystallises, and fuses at 152°C .; the tri-bromo-benzoic acid—



is also a solid crystalline substance, hardly soluble in boiling water, and fuses at 235°C .; the penta-bromo-benzoic acid—



is also a solid, soluble (as are also the two preceding) in weak alcohol, and fuses at the same temperature as the tri-bromo-benzoic acid. All these acids readily enter into combination with lime, forming regular and well-defined salts.

Results of Analyses of Compressed Peat from Switzerland.—Dr. Goppelsroeder.—(*Chem. Centralbl.*, No. 11, 1869.)—The air-dried substance contained in 100 parts:—Water, 23.17; ash, 7.87; carbon, 40.09; hydrogen, 4.53; oxygen, 21.50; nitrogen, 2.84. The material submitted to elementary organic analysis had been dried at 120°C . The ash contained chiefly sulphuric acid, lime, alumina, peroxide of iron, and silica; also chlorine, soda, magnesia, and traces only of phosphoric acid.

On the Lowering of Temperature due to the Solution of Salts in Water.—Fr. Rüdorff.—(*Berichte d. Deutschen. Chem. Gesellsch. z. Berlin*, No. 4, 1869.)—The decrease of temperature will be the greater the larger the quantity of any salt which water takes up at a certain given temperature. Since, however, water at a certain temperature only dissolves a definite quantity of any salt, the maximum decrease of temperature will be about that at which, under given circumstances, a fully saturated solution is produced. When, therefore, the salt and the water are applied in the proportion where from a saturated solution results, a long period of time elapses before the last portions of the salt are entirely dissolved, and the effect of the warm ambient air to some extent vitates the proper results of the experiments; the saturated solution should therefore be obtained as rapidly as possible. The experiments were conducted in the following manner:—The finely powdered salt and the requisite quantities of water were, previous to the making of the experiments, each put in separate beakers made of very thin glass, and placed for from 12 to 18 hours in a room wherein the temperature could be kept as nearly as possible constant; in consequence of this the beakers and contents attained the same temperature throughout. The mixing was effected by pouring the water on to the salt, and stirring up with a very delicate and highly sensitive thermometer; the maximum decrease of temperature took place within a minute after the mixing of the salt and water was made. The results of the experiments are exhibited in the following tabulated form, recording the average of a series of several experiments with one and the same substance, which were concordant within 0.2° :—

	Soluble in 100 parts of water.	Mixed with 100 parts of water.	The temperature falls		Number of Degrees.
			From $^\circ \text{C}$.	To $^\circ \text{C}$.	
Crystallised alum...	10.0	14	+ 10.8	+ 9.4	1.4
Chloride of sodium...	35.8	36	12.6	+ 10.7	2.5
Sulphate of potassa...	9.9	12	14.7	+ 11.7	3.0
Crystallised phosphate of soda...	9.0	14	10.8	+ 7.1	3.7
Sulphate of ammonia...	72.3	75	13.2	+ 6.8	6.4
Sulphate of soda (crystals)...	16.8	20	12.5	+ 5.7	6.8
Sulphate of magnesia (crystals)...	80.0	85	11.1	+ 3.1	8.0
Carbonate of soda (crystals)...	30.0	40	10.7	+ 1.6	9.1
Nitrate of potassa...	15.5	16	13.2	+ 3.0	10.2
Chloride of potassium...	28.6	30	13.2	+ 0.6	12.6
Carbonate of ammonia...	25.0	30	15.3	+ 3.2	12.1
Acetate of soda (crystals)...	80.0	85	10.7	— 4.7	15.4
Chloride of ammonium...	28.2	30	13.3	— 5.1	18.4
Nitrate of soda...	69.0	75	13.2	— 5.3	18.5
Hyposulphite of soda (crystals)...	98.0	110	10.7	— 8.0	18.7
Iodide of potassium...	120.0	140	10.8	— 11.7	22.5
Chloride of calcium (crystallised)...	200.0	250	10.8	— 12.4	23.2
Nitrate of ammonia...	55.0	60	13.6	— 13.6	27.2
Sulphocyanide of ammonium...	105.0	133	13.2	— 18.0	31.2
Sulphocyanide of potassium...	130.0	150	10.8	— 23.7	34.5

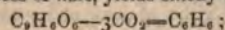
The quantity of water applied varied between 250 and 500 grammes, and the quantity of salt used corresponded therewith. The decrease of temperature obtainable in this manner can never fall below the freezing point of the saline solution in question, but can very nearly reach that. The sulphocya-

nide of potassium is the best salt to be adopted for the artificial production of ice; when 500 grammes of this salt are dissolved in 400 cubic centimetres of water, and the mixture stirred with a test-tube filled with water, the latter will be frozen in from two to three minutes. The degree of solubility of the salts referred to in the first column is made up according to G. J. Mulder's highly elaborate researches on this subject.

On Mesitylen.—(*Journ. f. Prak. Chem. v. Erdmann, No. 1, 1869*)—This is best prepared from acetone, by allowing it to be left first for twenty-four hours in contact with sulphuric acid diluted with half its bulk of water, and proceeding to the distillation of the mixture; after that time, in this manner a larger quantity of raw produce is obtained, which is next rectified by distillation over sodium. Treated with strong nitric acid, mesitylenic acid is produced, which forms, with bases, well-defined salts. Among the products of oxidation of mesitylen belong uvitinic acid and trimesinic acid, while mesidinic acid is an intermediate product. The following formulæ refer to these products, mesidinic and uvitinic acids being proved to be identical; the formula for the latter refers to the latter also:—

Mesitylen. Mesitylenic acid. Uvitinic acid. Trimesinic acid.
 C_6H_{12} . $C_6H_8O_2$. $C_6H_8O_4$. $C_6H_8O_4$.

Uvitinic acid is a solid substance, difficultly soluble even in boiling water, but readily so in alcohol and ether; it fuses at $288^\circ C$, sublimes without decomposition, and is a dibasic acid which readily forms salts with bases. Trimesinic acid, when distilled with excess of lime, yields chiefly benzol—



this acid is consequently a benzol wherein for 3H has been substituted 3COH.

Obtaining Coke quite free from Sulphur.—(*Moniteur de l'Indre France*).—The coke made in the usual manner is placed in an apparatus wherein it is heated at a temperature of about $300^\circ C$, and simultaneously submitted to the action of a strong current of atmospheric air compressed to between two and three atmospheres (30 to 45 lbs. to the square inch). By this means the sulphur is converted into sulphurous acid, and that gas removed by the strong current of air. Analysis of coke, before and after having been submitted to this process, proves:—(a) Not a trace of sulphur is left in any form in the coke submitted to the described treatment; (b) all the iron previously existing in the coke as sulphide has been converted into peroxide; (c) the calorific power of the desulphurised coke has become greatly increased, and is at least one-fourth more than that of ordinary coke; (d) experiments conducted on the large scale at iron works have proved that the coke treated as described produces iron as good in quality as that obtained with wood charcoal.

Preparation of Uric Acid from Peruvian Guano.—Dr. J. Löwe. (*Les Mondes*, No. 14, 1869).—In order to prepare uric acid from this material on the large scale, take equal weights of sulphuric acid and guano; heat the sulphuric acid in a porcelain basin placed on a water-bath, put the previously well-dried and ground-up guano, dried at $100^\circ C$, little by little into the acid, taking care to stir up the mixture with a glass rod, since during this operation much carbonic acid and hydrochloric acid gas are given off. It is necessary to perform the operation either in the open air or under a chimney hood with a good draught; as soon as the reaction ceases, dilute with from ten to twelve times its bulk of distilled water. A yellow precipitate soon ensues, and it is therefore preferable to perform the dilution, not in a basin, but in a cylinder glass. The precipitate having settled, the supernatant liquid is decanted, the precipitate first washed by decantation, and afterwards collected on a filter and washed until the sulphuric acid is nearly all removed; the precipitate is then, little by little, added to a boiling weak alkaline solution, and the uric acid precipitated from the alkaline fluid by means of hydrochloric acid. The crude uric acid thus obtained is purified by the processes of either Wöhler or Heintz.

On the Action of Pentachloride of Phosphorus upon Saccharine Substances.—A. Baeyer. (*Berichte d. Deutschen Chem. Gesellsch. z. Berlin*, No. 3, 1869).—When grape sugar is boiled with a mixture of pentachloride of phosphorus, oxychloride of phosphorus, and water, an amorphous, colourless, flocculent matter is formed, which dissolves in water on boiling; this indicates either the formation of an anhydrous substance or of a chloride; since, however, the sugar is, while being thus treated, readily decomposed, and this decomposition accompanied with a brownish colouration, the reaction cannot be satisfactorily studied. Cotton wool behaves, when treated with the same substances, in a similar manner; when gun cotton, however, is heated up to $200^\circ C$ in a mixture consisting of six parts of pentachloride of phosphorus and some oxychloride of phosphorus, the gun cotton is entirely dissolved in the latter substance without any decomposition. When the oxychloride and pentachloride of phosphorus are dissipated by evaporation by means of a current of air heated to $170^\circ C$, there is left a thick colourless liquid, which, on cooling, leaves a brittle gum-like mass; this substance is soluble in ether and alcohol, and insoluble in water, but on being boiled therewith decomposition ensues and a viscous substance remains. When the gum-like mass is treated with solution of caustic potassa, and heated therewith, it becomes brown; on being heated with hydriodic acid, iodine is separated. The substance in question appears to be a chloride of cellulose or of sugar, somewhat resembling the chlorides of mannite.

Test for the Genuineness of Chocolate.—M. Reinsch. (*Pharm. Zeitschr. f. Russland*, No. 2, 1869).—One part, by weight, of chocolate is ground to powder and mixed with ten times its weight of hot water, the mixture boiled for a minute, next cooled, and then poured on a paper filter. When the chocolate is genuine—that is to say, has not been adulterated with starch, wheaten flour, or starchy matter of any kind—the fluid is not thick, and easily runs through the paper; the filtrate is also clear, and exhibits a light brownish red fluid agreeable to the taste. The reverse is the case with adulterated chocolate.

NOTICES OF BOOKS.

Mémoire sur la Composition Chimique des Monneries Néerlandaises et sur la Volatilisation de l'Argent. Par A. D. VAN RIEMSDIJK, Docteur es Sciences. Pp. 38.

THIS is an abstract, reprinted and separately published from the "Archives Néerlandaises," vol. iii, 1868. The larger work was written and published in Dutch early last year. It treats on a subject which can only satisfactorily be experimentally studied in a well-arranged Mint; and Dr. Van Riemsdijk, having that opportunity at Utrecht Mint, has thoroughly gone into matters with great zeal and industry. It will be clear, even to a casual observer, that divers chemical changes must of necessity occur to the alloys intended to be converted into coin during the many operations the alloy is submitted to before it leaves the works; it is simply impossible to melt together two metals, and afterwards again anneal the partly rolled-out bars, without some chemical change being called into play. The various changes and effects also of the blanching and cleaning of the alloys have been studied and experimented upon by the author; he has extended his experiments not only to Netherlands, but also to Belgian, French, Peruvian, Bolivian, and Chilean silver coins. Gold coins are not made at the Utrecht Mint as current Netherlands coins; hence no experiments were made with gold. The author has also investigated the capability of silver, both pure and alloyed, for absorbing and occluding various gases, especially hydrogen and oxygen gas. On the whole, those who work in silver on the large scale, and are interested in the real composition and constitution of the alloyed metal, will find in this paper many very interesting and useful hints, while assayers will certainly read with pleasure the information contained in these pages.

The Voice, and How to Use It. By CHARLES JAMES BISHEN-
DEN, Professor of Singing. London: Published at 52, Mor-
timer Street, Cavendish Square.

THIS pamphlet treats entirely of the cultivation and preser-
vation of the voice for singing. The author, who has well
studied his subject, not only enters fully into the course of
practice required, but describes the mechanism of the vocal
organs, showing clearly and intelligently the influence they
exert; he also recommends careful attention to the diet,
which greatly affects the development and power of the
voice.

Town Life among the Poorest. By JOHN EDWARD MORGAN,
M.A., M.D. London: Longmans, Green, & Co.

DR. MORGAN read a paper on the dwellings of the poor in
towns, at a meeting of the British Medical Association, Ox-
ford, last August, and the pamphlet before us is a reprint of
this matter. The author remarks that the housing of the
poor, while beset with great difficulties, is most intimately
connected with the future prosperity of the great mass of the
people. In all our great cities, there are unhealthy quarters
where the death rate is exceptionally high, and the reason of
this, after careful inspection of many such places, Dr. Morgan
believes is to be found in this statement. Bad air, or too
little of it, kills the people.

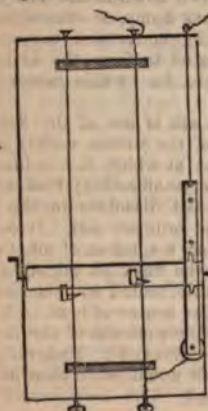
Men will grow robust and vigorous, the author remarks, on
very poor food, in very dirty cabins, and in very sorry attire,
provided they enjoy a pure and bracing atmosphere, and the
great physical development of the nations of the Hebrides and
the western highlands of Scotland is cited as an example. In
striking contrast to this, we find that in the Isle of St. Kilda,
a small island, numbering about eighty inhabitants, three out
of every five infants born alive are carried off a few days after
birth by a convulsive affection allied to tetanus, the difference
being apparently due to the huts having no smoke-hole in the
thatch, and being rendered impervious to air by double walls
filled in with peat and sods, the object of which is to prevent
the escape of smoke, and in due time the soot is collected and
used as manure. Space will not permit us to deal with the
details of the subject, but the data appear to be carefully col-
lected, and we believe that those interested in the subject will
find this little work worthy of their attention.

CORRESPONDENCE.

A Phono-electroscope.

To the Editor of the CHEMICAL NEWS.

SIR,—A little instrument which I have recently contrived
for the purpose of illustrating the heating power of the vol-
taic current, and which may be fitly called a *phono-electro-*
scope, consists of a rectangular wooden box, ten inches by



five, two steel or platinum wires stretched from end to end, a small spindle carrying two quill plectra, and an eccentric wheel for making and breaking the current through one of the wires. The wheel turns under a brass spring, which plays upon a button. The spring is connected with one electrode of the battery, the button with the wire nearest to it, and this wire with the other electrode. To exhibit the use of the instrument:—First, tighten the wires, by means of the milled-headed screws, to unison, to about the pitch of middle C; then turn the spindle so as to sound the two notes in succession before the eccentric wheel makes the circuit. After these have sounded in unison, turn the spindle

a little more; the circuit is made by wheel and spring, and presently the plectra plays a second time on the wires, which now sound, with an interval of a tone or more, according to the quantity of electricity which has passed through one of them. By regulating the time between the instant when the wires sound in unison and the instant when they sound again, and noticing the musical interval caused by one of them becoming flat, we have an audible measure of the expansion of the connected wire, or the temperature to which it has been raised, and of the quantity of electricity which has traversed it to produce that effect. By continuing the movement, the interval between the notes will increase, and at last the wire operated on will become too slack to sound at all. If connection with the battery be now broken, and the heated wire be allowed to cool, its note will be heard to rise by degrees to its original pitch. With a single pair of plates, the phono-electroscope answers well. The experiment is a striking one in a lecture-room, very instructive, and easily managed. The apparatus is so simple that any one almost may make it for himself.

EDWIN SMITH, M.A.

The Chemistry of Sugar Refining.

To the Editor of the CHEMICAL NEWS.

SIR,—I was led to infer from the tenor of Dr. Wallace's communications, that he supposed the fact that "weak acids invert cane sugar" was insufficiently known, or he would not have repeated it so frequently. The *reductio ad absurdum* of his concluding remarks on this subject is rather an old ruse, and quite unworthy of him.

My remarks on the calcic carbonate with which sugar refiners of this country load the carbon surface of their bone-black, had reference to that which is derived from impurities in the crude sugar, and not that found in new bone-black. Dr. Wallace admits in his papers, that the amount of calcic carbonate existing in bone black as in use in our refineries is a variable quantity, sometimes in excess, at others deficient; would it not, therefore, be preferable to get rid of it entirely (as it is not an essential constituent of bone-black, as far as the sugar refiner's use of it is concerned, as the Dr. would have us believe), either by the dry hydrochloric acid gas process, or by "others of a similar nature," if such can be found, and neutralise the acid of the crude sugar before submitting it to the action of the bone-black in the manner, as I have already said, which is in practice in other countries? Or the syrup of the crude sugar might advantageously be filtered through calcic carbonate in grains before passing it on to the bone-black filters: thus the complaints of "sour liquors and the occurrence of iron in the syrups" would cease.

I would, in conclusion, remind Dr. Wallace that the use of intemperate terms in a scientific discussion does not tend to bring conviction to the mind.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maidenhead, April 6th, 1869.

Discovery of the Weight of the Air.

To the Editor of the CHEMICAL NEWS.

SIR,—You will doubtless allow me, through your medium, to reply to Mr. Rodwell. I do so by first giving the text of Aristotle, according to the most authorised editions—viz., those of Berlin, of Didot, and of Du Val, in the 17th century, *Imprimerie Royale*:—

Ἐν τῇ αὐτῇ γὰρ χώρα πάντα βάρος ἔχει πλὴν τοῦ ἀέρος.
Σημεῖον δ' ἐστὶ ἔλκευ πλείον ὁ περιγεγραμμένος ἀσκὸς τοῦ κενοῦ.

"Suo enim in loco gravitatem habent omnia præter ignem, etiam ipse aer. Cujus signum est utrum inflatum plus ponderis quam vacuum habere."

"Dans son milieu, tout pèse, excepté le feu, y compris l'air lui-même. La preuve en est qu'une outre gonflée pèse plus que si elle était vide."

"In their own medium, all bodies, except heat, have weight, the proof of which is that a leathern bottle weighs more when filled with air than it does when empty."

Mr. Rodwell has asked for the original text; I give it to him with authorised translations, except, indeed, the English, in which language I have not been able to procure an edition of Aristotle. Besides, the word *ἀέρας*, which I find invariably in several editions, is sufficient to justify the "*utrum*," which is likewise found in all the Latin translations that I have seen; I might add that it is also the expression "*utrum*" which the majority of Latin commentators make use of.

Ptolemy, Simplicius, Seneca, and Socrates throw no light on this subject.

Ptolemy and Simplicius denied Aristotle's assertion, because they did not admit the theoretical explanation of the philosopher. Seneca might think what he pleased as to the opportuneness of the question; but because he threw jests on it, *en passant*, I do not see how they concern Aristotle. I pass on, then, to another point. Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air; but will it resist any effort made with the intention of bursting it? It would be superfluous to show here that this is a needless fear; prepared skins are not wanting, capable of containing, at least for some length of time, air at a greater pressure than that of the atmosphere; as for the difference in weight necessary to prove it, all depends on the volume of air experimented on. Let us admit the bulk of 15 litres, which is not exorbitant, and suppose that the pressure can be increased in the interior by 15 millimetres; there might be a difference of a gramme, and from thence it would be appreciable. Mr. Rodwell reasons, in the persuasion which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath. But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek smiths were acquainted with the use of bellows; and we read in the "Iliad" that more than twenty bellows were at work in Vulcan's forge for Achilles' shield. Besides, Mr. Rodwell seems to regard it as an undoubted fact that only rough and clumsy scales were in use at the period in which Aristotle lived. This is scarcely the case. If, at this time, gold was weighed with extreme care, why might they not have, I will not say balances indicating the 1-10th of a milligramme, but balances giving the decigramme, if not the centigramme. Mr. Rodwell refers to Aristotle's commentators who repeated his experiment and failed in their attempt. But, as I have said before, many of the philosopher's admirers disregarded his instructions on this point—Ptolemy, Archimides, Themistius, Simplicius, and a number of others. At the same time, Averroes affirms that he succeeded, and, if I am not mistaken, he is not the only one. If Mr. Rodwell wishes, I will, a little later, point out the text; at the present moment, I have not it before me. Why, then, congratulate those who did not succeed, since it is not proved that they and Aristotle must necessarily miscarry in the attempt.

Mr. Rodwell does not think that Aristotle cared much about the honour of passing for a good experimentalist; this astonishes me. Aristotle observed everything with the greatest care, and it is known that he has left little to be said on many branches of natural science, in all that was accessible to him. This is a eulogy which naturalists do not hesitate to accord him—M. Flourens, for instance, to quote only one example, in his refutation of Mr. Darwin's work.

Mr. Rodwell is not an enemy of the philosopher. It is an honour to him to render to this great man the homage

of esteem which he deserves. But it is a singular way of proceeding, to contradict, *without certain proofs*, the clear and explicit word of the most exalted genius that human reason, left to its own powers, has produced. Mr. Rodwell's hypothesis does not appear to me demonstrated; and far from being the certain proof, of which I have just spoken, it remains in the state of a supposition.

Finally, My honourable contradicter will find in these lines that the versions of Aristotle which translate *ἀέρας* by bladder are not in the right, that there is nothing to prevent the experiment succeeding by means of a leathern bottle; also, that unless something further than what has yet been advanced is proved, it does not remain a less established truth that Aristotle affirmed the fact of the gravity of air, and that he gave, as a proof of it, an experiment which neither disinterested commentators nor actual opponents have proved to be absurd. I cannot, then, understand why Mr. Rodwell has been so eager as he has shown himself in seeking to bring my opinion to nothing. If, in my answer, anything impulsive has escaped me, I disown it, having intended to oppose Mr. Rodwell only, with the greatest esteem for his learning, and the greatest courteousness towards him personally.

Such, Sir, is the answer I have thought it right to make to Mr. Rodwell; it will suffice, I hope, to make known my opinion, and to give all needful explanations to my worthy opponent.—I am, &c.,

THE ABBE A. HAMY.

Metz, March 16, 1869.

Sudden Crystallisation.

To the Editor of the CHEMICAL NEWS.

SIR,—I am obliged to Mr. Allen for his note respecting crystallisation, but am sorry it does not give me any information about my difficulty with respect to breakage of the flask. I have avoided the use of thick vessels, in consequence of their liability to crack in preparing the supersaturated solution, and I am at a loss to understand how Mr. Allen prepares his solution in a medicine bottle. Would he kindly inform me?—CRYSTAL.

On Solutions of Glauber's Salt.

To the Editor of the CHEMICAL NEWS.

SIR,—Your correspondent "Crystal" has written twice to ask for instructions how to prepare, for a lecture experiment on sudden crystallisation, a supersaturated solution of Glauber's salt without breaking the flask.

It is easy to do this if the heat be properly managed.

The salt parts with its ten atoms of water of crystallisation with so much ease, that if the heat be too suddenly applied, the anhydrous salt is thrown down in the form of a fine powder, which makes the flask bump, or causes it to crack, by fusing and by preventing convective currents. When once the anhydrous salt begins to form, the evil is increased by raising the temperature, for by this means its solubility is diminished.

As the ordinary solution of this salt is one of the anhydrous, and not of the 10-atom or of the 7-atom variety, attention must be paid to the point at which the ordinary 10-atom salt fuses in its water of crystallisation; that is, to the point at which the anhydrous salt dissolves in the 10 atoms of water that accompany the ordinary salt. It does so at about 93° F. Now, in making a solution of six, five, or four parts salt to one of water, the flask containing one of these proportions should be gently heated with constant agitation over a spirit lamp, or other source of heat, or in a water bath not over 100°, so that the contents of the flask may not much exceed 93°, or from that to 98°. Under these conditions, the salt will quietly melt down into a clear solution, which may be then left to boil. The boiling may be

greatly facilitated by the addition of some fragments of cocoa-nut shell charcoal, or even of a lump of coke or of pumice stone; but the charcoal is the best, on account of its superior density.

The boiling solution should be filtered into tubes, flasks, or bottles, made chemically clean by washing in caustic alkali, or sulphuric acid, spirit of wine, &c., and rinsing. The tubes, &c., may stand in hot water while being filled; or when filled, they may be passed over the source of heat, so as to raise them to near the boiling point before being plugged with cotton wool.

Such solutions may be kept for a length of time, clear and bright, without any change. On taking out the cotton wool, crystallisation sets in from the surface, and proceeds rapidly downwards, converting the whole into a solid mass so that the vessel may be inverted without any escape of liquid.

I think it is a loss to the lecture table that solutions of this salt are confined to the single illustration of sudden crystallisation; whereas a whole lecture might be profitably devoted to the consideration of this salt, as it respects the phenomena of supersaturation and the action of nuclei.

Did your space permit, I would write such a lecture; but I can only point out briefly a few experiments.

1. Put a tube, containing a cold but highly supersaturated solution, into a freezing mixture at 20° to 30° F.; in a few seconds, well-shaped octahedral crystals of the anhydrous salt will begin to descend. The tube may now be wiped and exhibited at the lantern, or handed about.

2. If the neck of a large flask be slipped over the neck of one of the flasks containing the boiling filtered solution, and this be set aside in a cold place for many hours, there will be found at the bottom of the flask crystals of the modified 7-atom salt (four-sided prisms, with a rhombic base). They should be bright and transparent. On inverting the flasks, the mother liquor may be discharged into the empty flask. If this be not clean, the liquor will become quite solid; but, with care (warming the neck of the smaller flask is a good plan), the crystals can be disengaged from the supersaturated mother liquor, and left to drain. If the crystals of the 7-atom salt be touched with a bit of wire or other solid, the point touched immediately becomes opaque, and the opacity spreads in all directions, until the whole mass becomes like the boiled white of egg.

3. Before closing one of the tubes with cotton wool, touch the inner surface at one spot with the finger slightly greasy. When the tube is cold, it may be inclined so as to bring the solution into contact with various parts of the glass: the clean portions have no effect; but the moment the solution touches the edge of the finger mark, crystallisation sets in.

4. If the solution be filtered into a stoppered bottle, and the bottle be closed and tied over, and shaken so as to wet every part, it may be left to cool. When cold, the bottle may be violently shaken; and the air, though long in separating, does not act as a nucleus. On loosening the stopper, air streams in, and drags in a particle of dust, which immediately acts as a nucleus.

5. Solids, whether porous or compact, boiled up with the filtered solution, are inactive when the solution is cold. So, also, is a glass rod, &c., made chemically clean. Or a metal or glass rod, passed through the plug, held in the boiling steam, and left suspended in the flask, is inactive when the solution is cold. Such a rod may become covered with a crystalline crust of the salt, and even this is not a nucleus.

6. A striking way of showing the sudden crystallisation of the salt is to boil a filtered solution in a flask, put the flask on a plate, and cover this with a bell jar. It may be left for weeks in this state without crystallising; but the moment after the bell glass has been lifted off the solution becomes solid.

7. If vessels with necks of different diameters be opened, the solutions are long in crystallising in proportion as the diameters are small. In vessels with very narrow necks, the solutions may not crystallise at all until a nucleus be inserted.

8. Faraday, in one of his juvenile lectures, gave some idea of the heat liberated during the crystallisation, by emptying a flask upon the bulb of a large spirit thermometer. The temperature commonly rises to about 85° F.; but the best salt for showing this effect in a lecture experiment is the sodic acetate. It is easy to show a rise from 19° to 105° F.

Many other experiments might be shown, such as the easy fusibility of the 7-atom salt, the milky appearance when the chilled solution is shaken, the varied action of nuclei, &c.; but these and other illustrations will naturally occur to any one who is going to give a physical lecture on Glauber's salt.—I am, &c.,

C. TOMLINSON.

Highgate, N., April 19th, 1862.

Jargonina.

To the Editor of the CHEMICAL NEWS.

SIR,—As some question has arisen about what Mr. Sorby has done, I think it might be well to give extracts from two of the letters received from that gentleman, during our long correspondence relative to a recent paper* in the *Proceedings of the Royal Society*.

"Sept. 30th, 1862.

"I forget whether I told you that I had discovered the most remarkable spectrum that probably anyone ever saw, in a zircon from Ceylon. It is quite unlike anything previously seen. It contains about a dozen absorption bands, which are not mere shades, like what is generally seen in solid bodies, but in narrow perfectly black lines, like those seen in the spectra of coloured gases. It is not due to zirconia, because some zircons show no trace of such a spectrum. As far as I can make out, the lines are not due to any substance known to produce absorption bands. So far, it is a complete puzzle, and I am half inclined to believe that it may turn out to be due to some unknown element. Unfortunately the amount of material at disposal is far too small to admit of analysis, and curiously enough, it does not give any bands when melted with borax, but only a colourless bead. I may say that the mineral which gives this wonderful spectrum is nearly colourless, and becomes almost absolutely so when red-heated, and remains colourless, but gives the same wonderful bands, when cold."

"Oct. 23rd, 1862.

"I have been led into a long series of work by the probable new substance. I am endeavouring to determine the spectra of all known elementary substances when combined with silica. There are only a very few that I have not been able to study, and hope to be able in time. So far as I see, no known substance would give the spectrum of the jargon I named.

"I have since examined a number of jargons and other zircons. There does not seem to be a trace of the new substance in any except those from Ceylon, and most of these only contain a small quantity, in comparison with the very remarkable specimen which must contain so much.

"I do not know if I told you that I suspect the existence of a second new substance. I may be wrong in both cases; but it seems difficult to draw any other conclusion from the facts at present known."—I am, &c.,

P. J. BUTLER.

55, De Beauvoir Road, N.
April 19th, 1862.

Sudden Crystallisation.

To the Editor of the CHEMICAL NEWS.

SIR,—I am afraid I can be of no further assistance to your correspondent "Crystal," as I have never met with the difficulty he describes. The bottle to be filled with the sul-

* "On the Structure of Rubies, Sapphires, Diamonds, and some other Minerals," vol. xvii., pp. 291-302.

phate is thoroughly warmed, and the hot solution filtered into it. The same quantity has been used by me several times, the solidified salt being re-dissolved by placing the bottle in warm water, which is then heated to boiling.—ALFRED H. ALLEN.

Decomposition Cell.

To the Editor of the CHEMICAL NEWS.

SIR,—Mr. Woodward's description of a glass cell reminds me of an arrangement I am in the habit of using, and a description of which may be of interest. The cell is made by cementing two pieces of window-glass on to a properly shaped piece of wood, by means of hot pitch. Platinum wires and plates present no difficulty; no clamps are required, and acids have little or no action on the pitch. A few weeks ago, I constructed a cell, by placing a piece of sheet gutta-percha between two glass plates heated before the fire. It lasted a few days, but then leaked; I think I can yet succeed in making it permanent. When the cell is to be exposed to great heat, as from the electric or lime light, the portion of the glass not required for transmitting light should be covered with tin-foil, which of course reflects the heat, instead of absorbing it like the pitch and gutta-percha.—ALFRED H. ALLEN.

Equivalence and Quantivalence.

To the Editor of the CHEMICAL NEWS.

SIR,—In your report of the last meeting of the Chemical Society appear some valuable remarks of the President, Dr. Williamson, on the injurious confusion which is introduced into chemical science by the indeterminate significance, and interchangeable use, of the two words *atomicity* and *equivalence*. Dr. Williamson deprecated the shifting and uncertain sense which had been attached to these expressions by various speakers during the evening's debate. He also demurred to the introduction of such words as "bond" to express the function or property in virtue of which chemical compounds are held together. "He would not," he added (according to your report), "express any opinion as to whether the *atomicity* theory was right, or the *equivalence* theory, but they were different."

While humbly supporting with my entire concurrence the earlier part of the learned President's observations, I would venture, with deference, to submit that, into his last above-quoted phrase, there seem to have crept some traces of that vagueness which he himself so earnestly deplors. Let me, however, hasten, in fairness, to say that the phrase, as reported, wears the aspect of an abridgment, in which the full sense of the speaker's words may have suffered by compression; so that it should be only after revision by Dr. Williamson himself that the report should be taken to convey his precise meaning.

With this reservation, I take the phrase as it stands in your columns, and ask permission, in the interest of neo-chemistry, respectfully to point out that, in referring to *atomicity* and *equivalence* as opposed theories, standing in such mutual antagonism as to comport the expression of an opinion "whether one or the other be right" the speaker seems to have been betrayed (doubtless by the haste of improvisation) into a temporary oblivion of well-known and momentous laws.

Those laws, and the most suitable forms for their expression, it devolved upon me to study with the utmost care, during my collaboration with Dr. Hofmann in his "Introduction to Modern Chemistry," and especially while writing the philosophical chapters of that work; a duty which, owing to the illustrious Professor's many and pressing engagements at the time, had, in a great measure, to be entrusted to my inferior hand.

If, therefore, it be opportune, during the prevalence of the unsettled opinions exemplified above, to submit for consideration statements of those laws, in terms at least free

from vagueness, whether otherwise admissible or not, I hope that my intervention to fulfil this duty will not, under the circumstances mentioned above, be deemed unduly obtrusive.

Thus much explained, and audience taken as therefore granted me, I strike at once into the heart of the subject, by offering, in the concise language at my command, exact definitions of *equivalence* and *atomicity*; or, as I prefer to term the latter, *quantivalence*.

To prepare the mind for grasping these definitions, I would first observe that the former expression, *equivalence*, is essentially *ponderal*, and is the answer (so to speak) made by each kind of matter to the question *How much?* while the latter expression, *quantivalence*, is essentially of *numerical* significance, and is the reply of each kind of matter to the experimentalist's question, *How many?*

This preliminary indication shows us, at once, that there is no such antagonism between these two aspects of chemical enquiry as Professor Williamson (if correctly reported) was led at the moment to suppose; that it is not necessary to enquire "whether one or the other theory be right," but that, on the contrary, both views may be true—*may*, not only *may*, but *must* be true, seeing that they are but the separate expressions of co-existent and co-relative facts.

The fact of which equivalence is the expression, is the reply which a material element makes, from the pan of the balance, to the question propounded in the retort or crucible—*How much of you, by weight, is the minimum quantity, relatively to an assumed standard-unit (H=1), requisite to take part in the formation of a compound molecule?*

To this clear question chlorine as clearly replies, 35.5; oxygen answers, 16; nitrogen, 14; carbon, 12; and so on throughout the elemental list.

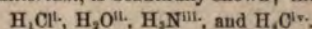
The fact which *quantivalence* (somewhat barbarously called also *atomicity*) purports to express, is the reply made by an element, to the analytic and synthetic interrogation:—*How many standard atoms (H=1) is your minimum molecule-forming weight, or equivalent weight, above defined, capable of fixing, to form a compound molecule, or of replacing, in a compound molecule already formed?*

To this distinct question (How many?), chlorine distinctly answers 1; the reply of oxygen is 2; of nitrogen, 3; of carbon, 4; and these numbers, written small, each against the name of the respective element (represented by its initial), denote the respective *co-efficients of quantivalence*. Instead of numerals, dashes, in appropriate number, are frequently used to signify these co-efficients, which conspicuously stamp on each element's symbol its relative atom-fixing and atom-replacing power, or (if I may so express the fact) its *chemical value in exchange*.

These quantivalential co-efficients find their most convenient spoken enunciation in the Latin numerical prefixes—*uni*, *bi*, *tri*, and the like. Thus: we call chlorine *univalent*, and write it Cl¹ or Cl'; oxygen, we term *bivalent*, and write it O² or O''; nitrogen we denominate *trivalent*, and write it N³ or N''' ; while carbon is designated *quadrivalent*, and written C⁴ or C''''.

Turning to the phenomena themselves, which afford us this distinct information, we find in equal volumes of hydrochloric acid, water, ammonia, and marsh-gas (all, of course, taken in the vaporised or gaseous condition), the constituents Cl, O, N, and C, in the proportions due to their respective equivalent weights—35.5, 16, 14, and 12; while, upon counting the standard atoms (H=1) in each compound, we find 1 in the first-named (HCl), 2 in the second (H₂O), 3 in the third (H₃N), and 4 in the fourth (H₄C).

By writing into these formulæ the respective co-efficients of quantivalence of the elements engaged, the balance of the forces in play, or, as I have ventured to call it, their *quantivalential equilibrium*, is beautifully shown; thus we have—



It is remarkable that the numerical quantivalence of the elements varies quite irrespectively of their ponderal equivalence, or relative combining weights; the combining

weights in the series above, for example, happening to diminish progressively, whilst the atom-fixing powers, on the contrary, increase, thus:—

Cl=35.5	fixes one atom only of H.
O=16	" two atoms "
N=14	" three " "
C=12	" four " "

These higher and lower numerical relations, or attractions, of the elements, are, nevertheless, to be carefully distinguished from the gradations, more or less intense, of their chemical activity, or (if I may so say) from the *specific chemism* of each. For example, the one atom of hydrogen which univalent chlorine fixes, may (and does) happen to be held with much more force than that which carbon, albeit quadrivalent, puts forth in grasping its four-fold complement of atoms. And so, again, to illustrate the point in another way, though potassium and hydrogen are both but univalent bodies, yet the former (K) by reason of its superior *specific chemism* for oxygen, takes oxygen from the latter (H) with explosive rapidity and force.

It is not, however, my present business to dilate on the beauty or to develop the conditions of these marvellous endowments of material bodies, so much better known to those I address than to myself. The strict limits I have here to observe extend only to the clearing up of certain prevalent misconceptions as to the precise import of the terms *equivalence* and *quantivalence*; as also of the latter's derivatives—*univalent*, *bivalent*, *trivalent*, *quadrivalent*, *multivalent*, and the like; derivatives, let me add, *passim*, of more classical construction than such hybrid terms as *monovalent*, *polyvalent*, &c., formed by the intermingling of Latin and Greek, and which I regret to see so often employed.

As for the alternative expression, *atomicity*, its meaning, as marked by its derivation, seems to be "indivisibility;" a meaning altogether inappropriate, otherwise than by a purely arbitrary convention, to express the idea of chemical value in exchange, which *quantivalence*, on the contrary, aptly denotes. *Atomicity* is, indeed, a weak neologism into which chemists seem to have drifted, for want of a better word, at the time when chemical philosophy was beginning to undergo its great modern transformation. Let us hope that so defective a term may soon give place, by common consent, to the more significant and appropriate term *quantivalence*.

Let us, in conclusion, also hope that between these two terms, *equivalence* and *quantivalence*, as well as between the great laws they imply, all ambiguity and confusion may henceforth cease.—I am, &c.,

F. O. WARD.

London, April 25th, 1869.

New Carbonic Acid Generator.

To the Editor of the CHEMICAL NEWS.

SIR,—This is but a modification of the spongy platinum hydrogen lamp, but the modification renders it very useful as a quick producer of gas on the lecture table. As in the hydrogen lamp, there are two receivers, one standing in the other: it is in the inside receiver that the charges are made. For the lump of zinc of the lamp is substituted a tray of perforated lead, with a rod, by which to hang in the receiver. A bit of lead is joined to the bottom of the tray (outside) to serve as a handle, when it is to be put into, or removed from, the receiver. The tray has three feet, which leave space for the handle, and allow the liquid to drain off well. For use, the tray is filled with soda crystals, and hooked into the receiver; acid and water put into the outer receiver. The action is now just that of the hydrogen lamp. One trayful of soda is quite enough for a long series of experiments, but if more be required, in a minute the tray is taken out, emptied, and refilled with crystals. Evidently this apparatus is just as useful for hydrogen production.

The tray will hold a large quantity of granulated zinc, and with strong solution a steady flow will be kept up, with the cock full open. The other day, when putting by this apparatus, I observed for the first time, an interesting example of a heavy body floating. Crystals of soda, even very large, floated to the top of the acid solution, supported, I presume, by the evolution of gas. The soda could not be less dense than the solution. The crystals first fell to the bottom and then rose to the surface. It is, however, evident that the solution must have a certain strength; for I tried a second solution, and in this only small crystals floated; tested with a hydrometer, the second solution was less dense than the first.—E. KERNAN.

MISCELLANEOUS.

Reducing Aluminium from its Ores.—Mr. A. L. Fleury, of Boston, U. S., mixes pure alumina with gas tar, resin, petroleum, or some such substance, making it into a stiff paste, which is divided into pellets, which are dried in an oven, then placed in a strong retort or tube, which is lined with a coating of plumbago. They are then exposed to a cherry-red heat. The retort must be sufficiently strong to stand a pressure of from 25 to 30 lbs. on the square inch, and be so arranged that, by means of a safety valve or tube, the necessary amount of some carburetted hydrogen gas can be introduced into the retort among the heated mixture, and the pressure of from 20 to 30 lbs. on the square inch be maintained. The gas alluded to is forced into the retort by means of a force pump. By this process the alumina is reduced and the aluminium remains as a spongy mass, mixed with carbon. This mixture is re-melted with metallic zinc, and when the aluminium has collected in a metallic state the zinc is driven off by heat. The reduction is due to the carburetted hydrogen gas under pressure. The time required for reducing one hundred pounds of alumina earth, cryolite, or other compound of alumina, should not be more than four hours; when the gas can be applied in a previously heated as well as strongly compressed state, the reduction takes place in a still shorter period.

The Royal Polytechnic.—The most striking of the Easter novelties at this institution is the large induction coil which has been made by Mr. Apps. It is 10 feet long and 2 feet in diameter. The core of soft iron weighs 123 pounds, and consists of wires each 5 feet long and .0625 inches in diameter. The primary coil weighs 145 pounds, and is composed of 3,770 yards copper wire. The secondary wire is 150 miles in length, and .015 inches in diameter. The galvanic current for the primary coil is supplied by 40 of Bunsen's cells. It is capable of producing a spark 29 inches long, and the flash will perforate plate-glass 5 inches thick. This huge and powerful coil will not only be valuable to Professor Pepper to illustrate the wonders of electricity to the general public, but we hope it will be used as a means for promoting scientific research.

The Gas Supply of the City of London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has, in accordance with the provisions of the 71st section of the City of London Gas Act, 1868, reported on the quality of the gas supplied to the City of London during the months of January, February, and March of the present year, from which it appears that the illuminating power of the gas supplied by the several city companies is as follows:

	Illuminating Power in Standard Sperm Candles.		
	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company	16.27	14.03	14.83
The Gas Light and Coke Company	16.28	14.38	15.26
Great Central Gas Consumers' Company	16.85	14.26	14.99

These are the results of examinations of each of the Companies' gas, three times daily at intervals of not less than an

hour, between the hours of five and ten o'clock in the afternoon. As regards the purity of the gas, he reports that ammonia has constantly been present in the gas of the Chartered and Great Central Companies; but that the gas of all the companies has been always free from sulphuretted hydrogen. The amounts of sulphur present in the gas in other forms has been as follows:—

	Grains of Sulphur per 100 cubic feet of Gas.		
	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company.....	18.92	11.70	15.00
The Gas Light and Coke Company.....	24.15	15.75	19.49
Great Central Gas Consumers' Company.....	24.00	7.03	12.28

Report on the Sewage of the City of Melbourne.

—Mr. W. Sydney Gibbons has kindly forwarded to us a copy of his report on this subject, from which report we briefly abstract the following:—It appears that as yet the City of Melbourne is not provided with a proper system of underground sewers, but a kind of cesspit filtration, suggested by Dr. Tracy, has been adopted, and Mr. Gibbons was requested to inquire into the efficiency of that system which, briefly described, has the following arrangement:—The water-closet is supplied by Yan Yean service, and by the bath-water of the house to the exclusion of kitchen slops. The cesspit, at a short distance from the closet, is a large stone chamber furnished with an iron grating, and a partition-wall dividing it into two parts except at the bottom. The dejecta are thus comminuted by the force of the stream of water beating against the partition-wall and the grating, so that before they reach the filter, the whole is homogeneous liquid. The filter, at the bottom of which the mixture enters, is a covered pit with an iron grating at a short distance above the bottom and another near the top. Between the two are layers of road-metal, oyster-shells, and a mixture of animal and vegetable charcoal. The author of this report made a very minute inspection of all things connected with this subject, and took at different places in Melbourne, samples of filthy sewage water in open gutters, which samples were analysed; the samples all agreed herein that they contained a large amount of organic matter and solid residue, while foetid exhalations and gases were freely given off; for comparison's sake the Yan Yean water from the main pipes was analysed, and this water found to be clear and sweet, yielded a solid residue of 8.736 grains to the gallon, of which 2.152 grains are organic matter. This water was free from ammonia and sulphuretted hydrogen; microscopic research of this water, as well as of the sewage water, proved the former to contain only such infusion as may also be met with in fresh sweet natural water, but in the case of sewage, myriads of all kinds of lower animal forms of life such as accompany foul and decaying organic matter were met with. As to the cesspit filtration arrangement, it was fully proved to be chemically inoperative, and mechanically incomplete. The lengthy and copious report, which is chiefly of local interest, proves that the city of Melbourne is sadly behind in proper sanitary arrangements, and deficient in the requisite means to carry off its foul and refuse matter.

The Chemical Society.—In the report of the discussion on Mr. Chapman's paper, in this number, Mr. Perkin's remarks are not quite clearly given, we therefore reprint them as follows:—

Mr. Perkin remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of other acids by the action of chlorine. In the case of acetates, he obtained chloride of methyl, and from succinates, the chloride of ethylene. He (Mr. Perkin) had made an examination of the chloride of methyl formed in this manner, and found that it produced the ordinary crystalline hydrate, and behaved just like the normal chloride of methyl.

The Royal Society.—Amongst the candidates for admission to the Royal Society this year, we find the names of

Henry Dircks, F.C.S.; W. Esson, M.A.; Professor G. C. Foster, B.A., F.C.S.; Peter Le Neve Foster, M.A.; J. Norman Lockyer; G. Matthay; Dr. Theophilus Redwood, F.C.S.; Cromwell F. Varley; and Dr. A. Voelcker, F.C.S. Altogether forty-five candidates are proposed, out of which fifteen are to be elected in June.

The Chair of Chemistry at Edinburgh.—On Wednesday last, at a meeting of the Curators of the University of Edinburgh, Dr. A. Crum Brown was elected to the Chair of Chemistry, in the room of Dr. Lyon Playfair, M.P., resigned.

Complimentary Dinner to Dr. Odling.—On the evening of Tuesday last, April 20th, a number of gentlemen who have been associated with Dr. Odling as past and present members of the Council of the Chemical Society in the thirteen years during which he has filled the office of Secretary, entertained the Doctor at a complimentary banquet, at the Albion Tavern, Aldersgate Street. The chair was occupied by Dr. Warren De La Rue, F.R.S., V.P.C.S., who was supported right and left by Dr. Odling, F.R.S., Dr. Tyndall, F.R.S., Professor Williamson, F.R.S. (Pres. C.S.), Sir Benjamin C. Brodie, Bart., F.R.S., &c., &c. The following is a list of those who took part in the entertainment:—Messrs. F. A. Abel, F.R.S.; E. Atkinson; J. Anderson, M.D.; J. Lowthian Bell; G. B. Buxton, F.R.S.; F. C. Calvert, F.R.S.; D. Campbell; A. H. Church, M.A.; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; F. Field, F.R.S.; D. Forbes, F.R.S.; G. C. Foster; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; D. Hanbury, F.R.S.; A. V. Harcourt, F.R.S.; C. Heisch; H. Letheby, M.A., M.B.; G. D. Longstaff, M.D.; N. S. Maskelyne, M.A.; A. Mathiessen, Ph.D., F.R.S.; G. H. Makins; E. J. Mills; Hugo Müller, Ph.D., F.R.S.; W. Maroet, M.D., F.R.S.; E. C. Nicholson; H. M. Noad, M.D., F.R.S.; W. H. Perkin, F.R.S.; D. S. Price, Ph.D.; A. P. Price, Ph.D.; T. Redwood, Ph.D.; W. J. Russell, Ph.D.; J. Denham Smith; A. Smee, F.R.S.; J. A. Voelcker, Ph.D.; H. Watts, B.A., F.R.S.; J. Williams; J. T. Way; and J. A. Wanklyn. Letters expressing regret at being unable to attend were read from E. Frankland, Ph.D., F.R.S.; T. Graham, D.O.L., F.R.S.; A. W. Hofmann, Ph.D., LL.D., F.R.S.; H. Benze Jones, M.D., F.R.S.; J. B. Lawes, F.R.S.; W. A. Miller, M.D., LL.D., V.P.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; H. E. Roscoe, B.A., Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; E. R. Stunck, Ph.D., F.R.S.; J. Stenhouse, LL.D., F.R.S.; and Colonel P. Yorke, F.R.S. After the usual loyal toasts, the Chairman proposed, in eloquent and appropriate terms, the toast of the evening, "The Health of Dr. Odling;" and drew attention to a handsome silver tankard, which had been presented by some of those present, appropriately inscribed, for Dr. Odling's acceptance, as a memento of this day. After this had been filled with an "ethylic compound of complex composition and high saturating power," as the Chairman aptly described it, and had been passed round as a loving cup to all present, it was presented to the Doctor. The Chairman concluded his able speech amid loud and continued applause; and the toast was drunk upstanding, amidst enthusiastic cheers. Dr. Odling replied in feeling and impressive words, in which he spoke of the great advantage and pleasure it had been to him to form the acquaintance of those distinguished men who had filled the Presidential chair, during the thirteen years in which he had occupied the Secretaryship of the Chemical Society. Appropriate speeches were afterwards made by Professor Williamson, as President of the Chemical Society; Professor Tyndall, on behalf of the visitors; Sir Benjamin Brodie, Bart., Messrs. Harcourt, Perkin, and Dr. H. Müller, as Secretaries; Professor Abel, Dr. Gladstone, Dr. Longstaff, Professor Anderson, and others. In the intervals between the speeches, Professor Abel performed a selection of operatic music on the piano, and songs, comic and otherwise, were sung by Mr. F. Field and also by Colonel Boxer, Captain Goodenough, Colonel De La Rue, and Mr. J. C. Brough, who were present as guests. Great credit is due to Messrs. Abel, Müller, and Nicholson, who formed the executive committee, for the admirable manner in which everything was organised.

CONTEMPORARY SCIENTIFIC PRESS.

AFTER an experiment of more than eighteen months, we have decided to discontinue this department of the journal, and we have made arrangements for giving abstracts of the contents, instead of the titles merely, of all original articles in the leading Foreign Chemical Journals. Those articles which are too comprehensive to be condensed well, if they are of sufficient importance, be translated in full, and inserted as soon as possible after their publication abroad. These abstracts will be printed in smaller type, thereby increasing the available size as well as the value of the CHEMICAL NEWS.

NOTES AND QUERIES.

Atomic Weights.—In former numbers of the CHEMICAL NEWS extended quotations have been given from Professor Stas's minute and masterly researches on "Atomic weights," published in 1860, and it is interesting to notice how closely his results coincide with those deduced from the investigations by Dr. Penny on the same subject in 1839, as shown in the following comparative statement:—

	Stas.	Penny.
Chlorine.....	35.457	35.45
Nitrogen.....	14.044	14.02
Silver.....	107.939	107.97
Potassium.....	39.137	39.08
Sodium.....	23.045	23.05

Camphor of Patchouli is quite white, not black, as stated in last number of CHEMICAL NEWS (*Am. Repr.*, May, 1869, page 268). I have a quantity in my laboratory which any one so interested may see.—SEPTIMIUS PIERRE.

Substitute for Black Lead for Fire Grates.—Can any of your readers inform me where to find a description of a kind of paint, made with potassic or sodic silicate, intended to replace the use of plumbago for fire grates?—H. M.

New Colour Test for Blood.—From some experiments made by Professor Bloxam, of King's College, in a public lecture, it appears that a mixture of tincture of guaiacum and ozonised ether (that is to say, a solution of peroxide of hydrogen in ether) instantly produces, with blood or bloodstains, a beautiful blue tint. Professor Bloxam mentioned that he had extracted a single linen fibre, in the case of a blood stain twenty years old, and with an almost inappreciable amount of stain on it; and had found the characteristic blue colour was immediately induced by the test, and readily detected by microscopical examination.—*Lancet*.

New Freezing Mixture.—In the notice among "Notes and Queries" last week of a "New Freezing Mixture," (*Am. Repr.*, May, 1869, page 267), there is an omission of the minus sign before the 8° Fahr., the temperature falling 8° below zero when from two to three ounces of material are used. I also find that the fluid obtained by mixing the powders mentioned in the note becomes solid in a day or two standing in a corked jar. The solid mass has the appearance of set plaster of Paris or damp chalk. The addition of a very little water appears to prevent this setting into a solid mass, but the chalky-looking citrate lies a long time in cold water without being dissolved. Further observations on the subject are necessary and may lead to interesting results.—JOHN GALLETT.

Action of Leaves on Carbonic Acid.—In order to answer the oft-doubted fact of the decomposition of carbonic acid and the formation of oxygen by the leaves of plants, Boussingault has introduced into mixtures of carbonic acid gas and hydrogen and the former gas and nitrogen first a clean stick of phosphorus; as long as no oxygen is present, this element does not undergo slow combustion, thereby giving off vapours, but as soon as a green leaf of any plant was carefully brought into the gaseous mixtures standing over mercury the slow combustion of the phosphorus began, owing to the decomposition of the carbonic acid and formation of oxygen; this action takes place also in diffuse daylight, but not during twilight; leaves wherein the chlorophyll is not fully developed do not act in this manner.

Test Paper for Detecting Minute Traces of Hydrocyanic Acid may be prepared, according to Schönbein, in the following manner:—Good filtering paper is thoroughly soaked in tincture of guaiacum wood containing at least from 3 to 4 per cent of resin. After drying, it is moistened with water containing in solution 0.25 per cent of sulphate of copper; this paper becomes coloured blue as soon as it is placed in contact even with very minute quantities of hydrocyanic acid. Test paper prepared with a solution of iodide of potassium and starch solution, will, when previously also moistened with the above-named solution of copper, become blue when placed into contact with small, otherwise not readily perceptible, quantities of hydrocyanic acid.—*Schweiz. Wochenschr. f. Pharm.*

Testing Glycerine for Sugar, Dextrin, Gum, and Glucose.—When glycerine, previously diluted with from 20 to 24 times its bulk of water, is mixed with a few drops of a solution of molybdate of ammonia, while also a few drops of nitric acid are added, the fluid, on being heated to boiling point, becomes coloured blue, when the glycerine has been adulterated with a solution of sugar; when dextrin is present, the reaction is not so marked, and the colour rather more greenish. But Dr. A. Vogel, who investigated this subject, states that the adulteration of glycerine by dextrin and glucose is infallibly detected by

the well-known liquid, a solution of a salt of copper to which a solution of tartaric acid and caustic potassa are added, applied to the detection of grape sugar; as for gum, the molybdate of ammonia is a good test. The presence of gum in glycerine is indicated by a more pale blue colour.—*Industrie Zeitung*.

Testing the Decolourising Power of Animal Charcoal.—According to Tissandier, 10 grammes of a good specimen of this material carefully made, and also 10 grammes of the sample to be submitted to experiment, are taken and reduced to a very fine powder; each quantity is then placed on a paper filter of equal size, and next there is poured over the charcoal a quantity of 20 c.c. of a solution of rather dark brown sugar dissolved in water; the same quantity is repeatedly poured over the charcoal until the fluid which passes through the filter is of the same dark colour as the dark coloured sugar solution used. When, for instance, the liquid runs through the normal animal charcoal, as dark coloured as the originally applied solution, after eight doses of 20 grammes each, while such happens to occur with the charcoal to be tested after four of such doses, it is clear that the decolourative effect of the latter is only half that of the former.—*Moniteur Ind.*

Gas Purification.—Mr. Gasch, Inspector of gas works at Neunkirchen, Prussia, has made a series of experiments with the view to settle a question which is also of scientific interest, viz., whether carbonic acid is expelled from its combination with lime (as formed in the purifiers of gas works) by sulphuretted hydrogen, or whether the reverse action takes place. The results obtained are the following:—*a.* Carbonic acid expels hydrosulphuric acid from its combination with lime. (The combination of hydrosulphuric acid with lime appears to be CaS, HS). *b.* Hydrosulphuric acid does not expel carbonic acid from carbonate of lime. *c.* When either illuminating gas, coal gas, or atmospheric air are passed through layers of sawdust, carbonic acid is expelled in large quantity, especially at the beginning of the operation, or when the temperature of the sawdust is artificially increased. *d.* Lime, which has been fully saturated with carbonic acid, absorbs hydrosulphuric acid very energetically as long as it is moist, while no gas is expelled from it.—*Journal für Gasbeleuchtung*.

Dilatation of Petroleum by Heat.—M. Sainte-Claire Deville has recently called attention to a danger in respect to petroleum, paraffin oils, and the like fluids in consequence of the very great dilatation these liquids undergo by changes of temperature of the atmosphere no greater than those observed from winter cold to summer heat. Deville advises that casks and other closed vessels containing petroleum should never be filled, as the terms runs, full to the bung, for if this be done with the aforesaid liquids, there is an imminent danger of the vessels containing them being forced asunder by the mere dilatation of the liquid contained in them by an increase of temperature. It is, therefore, especially in cold weather, absolutely necessary to guard against entirely filling casks and other vessels entirely with petroleum and all similar fluids, since the bursting of the vessels may become attended with danger and risk of fire; explosion also may ensue by the vapour becoming mixed with air.—*Abridged from Moniteur Belge*.

Positive or Negative.—"A Medical Student" is suffering from a common form of confusion of ideas and terms. The galvanic current is set up at the surface of the zinc and is due to the force set free by the zinc while displacing hydrogen from the acid. Thus the zinc is the positive plate or element of the battery; the current passes through the liquid to the negative plate or element, the copper, platinum, or carbon, which merely collects the force and transmits it. As the current consists of polarised molecules there is a positive and negative at every point wherever the circuit is opened, and the side of the opening to which the current comes on its road from the zinc through the liquid is always the positive; therefore the wire leading from the negative element of the battery becomes its positive pole, and when connected to another cell, it is the positive element of that cell; thus, if led to another battery cell, it is continued in the zinc or positive plate; if to a decomposition cell, it is the positive pole or anode, to which proceed the negative portions of the compounds under electrolysis, therefore called anions, which are the chlorous or acid elements and radicals. But they do not go to the anode from any "attraction" in themselves, or if free, they only range themselves in that order of polarity when forming parts of a molecule capable of being polarised and separated into two distinct components, therefore only binary compounds can be directly decomposed by the electric current. The terms zincode and platinode are merely confusing nuisances. The wire from the zinc plate is of course the negative pole of the battery; it is the road by which the electricity returns, to use a common phrase; really it is the completion of the circle of polarised molecules which is the essential character of a galvanic current, for only when that is provided is electricity developed; when chemical action takes place without this condition of a complete molecular chain, heat is developed by the action instead of electricity, in ratios which prove the two to be the same force under different conditions. Thus, in the cells, the current goes from zinc to copper; in the circuit its course is from copper to zinc.—JOHN T. SPRAGUE.

Positive or Negative.—Perhaps I might be allowed to answer "A Medical Student," who, in your impression of March 19 (*Am. Repr.*, May, 1869, page 267), asks for information about the poles of the voltaic battery. In the first place he must remember that the positive element or plate is not the same as the positive pole, in fact, just the reverse, and this, I expect, is what has confused him. Now suppose we have a battery cell, the plates of which are zinc and copper, and the fluid the ordinary dilute sulphuric acid. The zinc is acted upon and oxidised by the acid, but the copper is not; the zinc therefore becomes positive, and the copper negative. A current of electricity would now pass from the Zn to the Cu if it could, but as a current can only pass in a circuit and never in a straight line, the particles of the liquid are merely polarised and put in a state of tension; but if the plates are connected by a wire outside the cell, the circuit is completed, and the current can now pass from the zinc, through the liquid to the copper, thence back

by the wire to the zinc. Now it must be noticed that the current in the battery passes from Zn to Cu; but outside, or in the wire, from Cu to Zn. That pole from which the current starts is called positive; therefore the zinc is the positive plate or element. But the copper wire is the positive pole, end, or terminal, or the anode; the copper plate is the negative plate, but the zinc wire is the negative pole or the cathode. Those substances which, on decomposition, appear at the positive pole or copper end are termed anions, viz., O, Cl, I, and the acids. Those which appear at the negative or zinc pole are cations, viz., hydrogen, the metals, and combustible substances in general. Once more, the Zn is the positive plate, but negative pole; the Cu is the negative plate, but positive pole.—SIRIUS.

Substitute for Black-Lead for Stoves.—A concentrated solution of silicate of potash or soda, to which may be added mineral substances as colouring matter; for instance—for white, tin-ash, precipitated sulphate of baryta, oxide of zinc, and the like; for red, Venetian red and divers shades of oxide of iron, also red ochres; blue, ultramarine, cobalt blue, and such like substances; but the question is, even if the drying goes on well, will not the dry material scale off readily again; or of course it will somewhat depend on the more or less roughness of the surface of the iron. Paint made with boiled linseed oil is out of the question where heat has to be endured, and, moreover, it sticks to iron, in consequence of the peculiar properties of the oil itself. There is no patent for the employment of silicate of soda.

Skeleton Lectures.—There is now some hope that scientific instruction will in future form no inconsiderable part in the educational curriculum of our public schools and schools in general. I believe the extension of this important branch of knowledge may be greatly extended amongst those who have passed their school days without this advantage if some enterprising philosophical-instrument maker would supply skeleton lectures with the necessary instruments and apparatus to illustrate them on loan and reasonable terms. "Skeleton Sermons" are much in vogue, and why not skeleton lectures on science, well arranged and adapted for the special experiments to make them both interesting and intelligible. I am quite sure there are hundreds of intelligent persons who now devote themselves to "Penny Readings" would be too glad to give brief lectures on popular science, if they could only hire the necessary apparatus, &c., to give them interest; a scientific lecture without experiments, is like a body without life. I shall be glad to see this suggestion carried out.—W. LITTLE, Hockington Hall, Lincolnshire.

Detection of Minute Traces of Hydrocyanic Acid.—Pagentecher some time ago pointed out that guaiacum resin with hydrocyanic acid, and some salt of copper, caused a blue colouration. More recently Schönbein has shown how to prepare test paper of great sensibility with tincture of the above-named resin, for detecting hydrocyanic acid; but the following observation of the same sensibility of the shavings from which the resin is derived, especially with the shavings of the lignum sanctum, is, I believe, new. Moisten a few shavings with a weak solution of sulphate of copper, place them on a piece of perforated paper over the mouth of a bottle containing cherry-laurel water; after a few minutes the colouration will take place. By the same way I have confirmed M. Louzet's observation of the existence of a minute dose of a cyanide in salivation. Moisten a few shavings with the weak solution of copper, upon simply splitting upon it, immediately the blue colour will appear.—S. CONN, London, April 5, 1869.

On a Momentary Molecular Change in Iron Wire.—Mr. Gore, F.R.S., whilst making some experiments on heating strained iron to redness by means of voltaic electricity, observed that, on disconnecting the battery and allowing the wire to cool, during the process of cooling the wire suddenly elongated, and then gradually shortened until it became quite cold. The amount of elongation of the wire during the momentary molecular change was usually about 1-240th part of the length of the heated wire; the molecular change evidently includes a diminution of cohesion at a particular temperature during the process of cooling, and it is interesting to notice that at the same temperature during the heating process no such loss of cohesion nor any increase of cohesion takes place; a certain temperature and strain are therefore not alone sufficient to produce it, but the condition of cooling must also be included. A large number of experiments were made with great care with wires of palladium, platinum, gold, silver, copper, lead, tin, cadmium, zinc, brass, German silver, aluminium, and magnesium, but in no instance could a similar molecular change to that observed in iron be detected. This molecular change would probably be found to exist in large masses of wrought-iron as well as in small specimens of wire, and would come into operation in various cases where those masses are subjected to the conjoint influence of heat and strain, as in various engineering operations.

Dutch Liquid.—Can any one please inform me of a cheap and continuous process of making quantities of Dutch liquid or olefant gas?—JAMES LISTER.

Sand-Storm.—The *Moniteur* of April 6th mentions that at Naples, Messina, and the whole of Southern Italy, daylight, during the day of March 24th, was so obscured by the sand of the African deserts, that at Reggio and many other places lamp-light had to be resorted to as a means of enabling people to perform their daily work; the sand was carried by the south wind even as far as Turin. Professor Palmieri recognised the true nature of this sand by means of the microscope.

Action of Ammonia on Phosphorus.—Some very interesting and curious experiments on the action of ammonia on phosphorus have been published by M. Blondlot. When a piece of phosphorus is kept in strong liquid ammonia, it becomes first brownish, then green, and finally deep black. At the same time that these changes of colour occur, the phosphorus becomes hard and brittle; it cracks and splits, and ultimately falls to powder. Solar light favours this change remarkably, causing it to become manifest in several days, while in dark, more than a year is required for its accomplishment. The most concentrated am-

monia produces the most rapid and decided change. The black phosphorus may be easily rubbed down to fine powder in a mortar with some water; it may then be dried on a water bath. If it retains any unchanged phosphorus which would cause its ignition, this may be removed by washing with sulphide of carbon. Passed through a fine sieve it constitutes an intensely black impalpable powder, which may be preserved under water without sensible alteration, but if exposed dry to air it slowly evolves a trace of ammonia, and, little by little, becomes yellow. In this state it resembles amorphous phosphorus in several of its chemical characters, although in some others it differs considerably, and notably in colour. The yellow powder heated in a tube to 200° C. evolves some phosphuretted hydrogen, and passes to ordinary amorphous phosphorus; treated with ammonia, it re-assumes in the course of an hour its original black colour. Although Blondlot has not accurately determined the chemical nature of these changes, he is inclined to regard the powder as containing solid hydride of phosphorus and hydrated amorphous phosphorus.—*Pharmaceutical Journal*.

Decomposition Cell for the Oxy-Hydrogen Lantern.—A simple and convenient arrangement may be made as follows:—take two square pieces of plate glass, and also two square pieces of vulcanised india rubber, all of the same size. Cut the rubber so as to form two pieces, each of the shape □. Two platinum wires, serving as electrodes, are then placed between the two pieces of rubber, the glass plates placed one on each side of the rubber frames, and the whole fastened together by clamps at the edge. The cell I have made is 2 inches square, and the rubber $\frac{3}{4}$ of an inch thick.—C. J. WOODWARD, Midland Institute, April 13th, 1869.

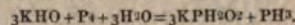
New Mixture for Tempering Steel.—A locksmith at Mulhouse, named Herr-nsehlidt, claims to have discovered a mixture which is said to give to the commonest steel the grain and temper of the finest cast metal, and moreover, to have the power of bringing back the original quality of steel which has been burnt. The mixture is composed as follows:—With 16 litres of distilled water mix 1 kilogramme of hydrochloric acid, 10 grms. of nitric acid (sp. gr. 1.334), 21 grms. of sulphate of zinc, and 100 grms. of tripoli. In this mixture is to be placed a piece of cast-iron of the first fusion, weighing 100 grms. When the acid mixture has acted for twenty-four hours, the composition is ready for use in the ordinary way, which, in all likelihood, means for cooling therein previously heated steel, and the composition remains effective till it is all used.—*Mining Journal*.

Detection of Diamonds.—Several of your contemporaries quote what they call a safe and easy, but after all a clumsy, method of testing the true nature of diamond, by burying it in powdered fluor spar, placed in a platinum crucible, pouring strong sulphuric acid over it, and exposing the crucible to heat on hot charcoal, with the precaution to be attended to, not to breathe the fumes. It need hardly be mentioned that since fluid hydrofluoric acid is sold in gutta-percha-made bottles, and whereas the acid thus sold is sufficiently concentrated strongly to attack any glass, even that called *strass*, generally used to imitate diamonds, there is no need whatever for performing an experiment as described, which in inexperienced hands may become dangerous. The liquid acid alluded to is quite efficient enough to test diamonds, if it is required to do so, by this means; the fluid sold also attacks native quartz.—Q.

Cement for Leather is best made by mixing with ten parts of sulphide of carbon one part of oil of turpentine, and adding thereto so much gutta-percha, as, by dissolving in this mixture, will form a tough, thickly flowing liquid, like treacle. The cement is applied to both pieces to be joined, the surfaces brought into contact, and pressure applied until the joint is dry. One essential requisite of success is the perfect freedom of the surfaces to be joined from all grease.—*Coach-maker's Journal, U.S.*

Wood Pulp.—Will any of your obliging contributors kindly inform me how to operate on wood shavings to convert them into white pulp? I have found them difficult to bleach even while employing much of the chloride of lime; the alkali I use is caustic soda, and the acid sulphuric. My results are not at all good; all I can obtain is a yellow pulp.—PAPER.

Electricity and Phosphuretted Hydrogen.—In making phosphuretted hydrogen the following formula is used:—



To the above, in a test tube, I added a small quantity of iodine, and heated gently. In addition to PH_3 , I observed for the first time that electricity was given off. Will any of your correspondents kindly explain if there be a connection between the above method of production of electricity and the common method with zinc and sulphuric acid, &c. &c.—LEX, Liverpool.

[Will our correspondent inform us how the electricity was detected?—E. C. N.]

Melting and Solidifying Points of Fatty Matters.—M. Wimmel has proved, by a series of experiments, that the generally accepted rule, that the degree of temperature of solidification, and melting of solid fusible substances is exactly the same, does not hold good for fatty substances. Those properly so called—that is to say, those which yield glycerine on decomposition—become solid at a temperature far less high than that at which they become fluid; substances like beeswax and spermaceti become solid immediately their temperature falls below their melting point. M. Wimmel has found that when the solidification is retarded, there is always an increase of temperature when the solidification takes place. The fatty substance known as butter of mace becomes suddenly solid at 33° C., and this solidification is accompanied by a sudden increase of temperature to 42° 25', while the melting point of this fat is 45° 5'. Some fats, like beef and mutton suet, do not become clear and quite transparent unless heated far above their melting point, while beeswax and spermaceti become transparent and clear long before they are entirely molten.

Mutual Decomposition.—Analysis of Sewage.—Perhaps you will

be good enough to inform a new subscriber under what conditions of temperature and others, sulphate of lime and carbonate of magnesia mutually decompose each other, and form carbonate of lime and sulphate of magnesia; the approximate temperature at which the decomposition takes place; if the transposition of the acids is complete or partial; and, particularly, if the presence of silicate of alumina in large quantity, and of peroxide of iron in small quantity, may be expected to accelerate or retard the effect? And also if you will please point out any treatise showing the best mode of analyses of sewage and of water, particularly the quantitative determination of ammonia of nitrates, nitrites, and of phosphates.—W.

Preparation of Olefant Gas, and the so-called Dutch Liquid.—Many years ago Mitscherlich discovered a process for the preparation of olefant gas, which yields it almost continuously, and gives, at the same time, a very pure product. This process is based upon the fact that a sulphuric acid of such strength as to have its boiling point at 165°C . (a mixture of 10 parts by volume of strong sulphuric acid and 3 of water), decomposes the vapour of strong alcohol into water and olefant gas. The full description of this process and also the simultaneous preparation of elayl chloride, or Dutch liquid, cannot be well understood without a woodcut; we therefore refer our correspondent to the very elaborate and full description to be found in vol. IV., pp. 545 to 558, of the *Handwörterbuch der Reinen und Angewandten Chemie von Liebig, Wöhler, and Poggendorff*, Brunswick, 1849, which work may be inspected at the Library of the Commissioner of Patents.

Aluminium Bede.—It appears that some Belgian manufacturer has just had a bell cast of aluminium, and with very good results. It is of course extremely light, so that, though large, it can be easily tolled; its tone is reported to be loud and of excellent pitch. Aluminium is the most sonorous of all metals.—*Engineer*.

Carbonic Acid.—Do you see any objection to common washing soda as a source of carbonic acid? I have used it now for years, and find it a very great convenience. There is a total absence of fumes, as I use sulphuric acid and water; there is an abundant supply of gas, and, above all, there is very rapid production, so desirable in class experiments. Still, as none of "the books" mention it, I hesitate to teach that soda is a better carbonate to use than marble or chalk. In one of his Christmas lectures (*CHEMICAL NEWS*, xix., 101—*Am. Repr.*, April, 1869, page 200), Dr. Odling coloured the gas brown. How is that to be done?—E. KERNAN.

"How to Prevent the Spread of Scarlet Fever."—A few weeks ago, some suggestions on the above subject appeared in a medical paper, and were reprinted in a leading journal; the idea of the writer was that the plentiful use of "green copperas" as a disinfectant would prevent the spread of fever; the germs of which, from the drains, often penetrate into the wells and contaminate the drinking water. Allow me to ask a question, with reference to the plan above stated. This disinfectant is, I believe, a poison; and is there not danger from its infecting the water? If so, the remedy would be as bad as the evil that is sought to be cured. I throw out the hint, only suggesting the question for discussion, and not pretending to give any opinion upon it; it is a matter, however, well worthy the attention of your readers.—*SANITAS*.

Mutual Decomposition.—*Analysis of Sewage.*—About forty years ago, researches were made concerning the first part of this query by Dr. G. J. Mulder. The printed memoir containing the result of these researches is out of print. But the precise answer to this somewhat complicated subject, depends on the conditions under which the salts are brought together; also, whether or not organic matter is present. The presence of the silicate of alumina, and of the peroxide of iron, has very little, if any, influence at all. There are plenty of excellent treatises on analytical chemistry, published in various languages, the titles of which "W." may be informed of by any bookseller. There is no necessity to specify any of these books in our pages.

Safety Matches.—It is well known that serious accidents occur from fire, caused by persons carelessly throwing down matches, which they believe to be harmless because the flame has been extinguished, but which, in reality, are highly dangerous, and quite capable of communicating fire to any light, dry material, in consequence of the wood splint being at a red heat, although not actually in flame. It has been proposed, in order to prevent this, to saturate the splints, previously to their being dipped, with a solution of some chemical salt which has the property of preventing the wood from remaining at a red heat after the flame has been extinguished, without being in any way detrimental to the inflammable nature of the splint, and thus to prevent the possibility of accident from the dropping of the match after the extinction of the flame, but while the splint is still at a red heat. The substance which it is proposed to employ is alum, though other salts have the same property. The mat has, before being dipped, are to be immersed in a strong solution of alum, or other salt with similar action, until they are saturated; they are then to be dried and tipped with the ordinary composition. Matches, so treated, are said to ignite and burn with flame as long and as readily as other matches; but the instant the flame is blown out the match becomes black and perfectly harmless.—*Scientific American*.

On Luteline and the Spectra of some Yellow Organic Substances.—By Luteline, Dr. Thudicum understands a yellow crystalline substance occurring in various parts of animals and plants, as, for instance, the corpora lutea of ovaries, serum of blood, yolks of eggs, in seeds, as maize (Indian corn), in annatto, in carrots, and the stamina and petals of a great many flowers. Luteline is easily soluble in alcohol, ether, and chloroform, insoluble in water; these solutions are yellow, but that in chloroform, when concentrated, has an orange-red colour. Spectrum of solutions is distinguished by great brilliancy of the red, yellow, and green part, and by three absorption bands, which are situated in the blue, indigo, and violet part of the spectrum. The crystals of luteline are apparently rhombic plates, of which two or more are always superposed in a curious manner. The crystals are microscopic, yellow when

thin, orange to red when thick, and have no resemblance to any other known animal or vegetable substance. Luteline combines with few substances, mercury-acetate being, perhaps, the only reagent by which it is immediately and completely precipitated as a yellow deposit; mercury-nitrate produces a yellow precipitate which, on standing, becomes white. Nitric acid poured over the crystals, produces a blue colour, which immediately passes into yellow. The blue is not produced when nitric acid is added to either the alcoholic, ethereal, or chloroformic solution of luteline, but appears with the acetic acid solution and disappears again rapidly. Luteline has great affinity for fatty matters and for albumine.

Sulphide of Carbon Light.—Mr. D. Winstanley describes (in the *British Journal of Photography*) an apparatus consisting of a water-bath heated by a Bunsen gas burner; within the water-bath is placed a vessel, to hold disulphide of carbon. The outer and inner vessels are firmly soldered together, and proper arrangements are made to enable the experimenter to pour water in the outer vessel, which is also provided with a neck to hold a thermometer, serving to indicate when the temperature at which the bisulphide of carbon contained in the inner vessel boils. The inner vessel is provided with a neck, closed by a well-fitting cap when the apparatus is in use, for the introduction of the fluid bisulphide of carbon; beside this, there is soldered to the inner vessel a gas-pipe of small bore, which pipe projects at a convenient height above the outer vessel; to this pipe is soldered and connected at right angles another pipe, provided with a stop-cock, and further connected, by means of elastic tubing, with a gas-holder containing oxygen gas made from chloride of potash. After the application of gas-flame beneath the water-bath, the thermometer is watched, until it indicates that the vapour of the bisulphide of carbon is issuing from the burner (from the gas-pipe connected with the inner vessel); the heat is allowed to continue beneath the water-bath until the flame reaches the flaring point, when it is lessened almost to extinction. The oxygen gas is then cautiously introduced, upon which the flame at once diminishes in size and increases greatly in brilliancy. This light is proposed for use in photography on account of its great actinism; as a source of intense heat it may also, perhaps, be recommended.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS give notice that in accordance with a suggestion of Mr. CROOKES, the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with Mr. CROOKES render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of

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Communications have been received from O. Lodge; W. H. Walcott; Dr. E. Fleischer; R. Calvert Clapham; W. H. Perkin, F.R.S.; W. Smith; J. Barrow; H. McLeod; L. W. Leeds; C. H. Osborn; Dr. Letheby; A. G. Pritchard; J. W. Young; L. Walters; E. T. Chapman; C. S. Watson; J. Fisher; Pierre Clavel (with enclosure); W. M. Watts; E. Smith, M.A.; J. W. Slater; H. J. Jones; W. H. Darlington; G. Cranston (with enclosure); J. C. Lee (with enclosure); The Bede Metal Company; W. Wallace; H. C. Sorby, F.R.S.; A. H. Church, M.A.; Dr. E. Davy (with enclosure); F. S. Sillicoe; Gossage and Sons (with enclosure); Mottershead and Co. (with enclosure); W. J. Morgan; E. Bird; Dr. Röhrig; H. Nathan; T. Hill; W. Perkin, F.R.S.; H. C. Sorby, F.R.S.; J. Lister; C. H. Osborne; A. G. Pritchard; E. T. Chapman; E. A. Erlandson; F. W. Hart; J. Spiller; D. Jefferson; H. Rich; H. Sewell; Dr. R. A. Smith, F.R.S.; T. C. Ansdell; D. Brown; R. E. Branton; J. B. Ledshaw; Dr. Röhrig; A. H. Allen (with enclosure); E. Bloom (with enclosure); S. W. Rich; B. Leeson; E. G. Tosh; Dr. Balfour Stewart; The Magnesium Metal Co. (with enclosure); and J. Heywood.

Books Received.—"Thèses Présentées à la Faculté des Sciences de Paris, pour obtenir le Grade de Docteur en Sciences Physiques." Par M. Stanislas Meunier. Paris: Gauthier-Villars. "Power without Fuel: an Investigation of the Means by which it may be obtained from the Heat of Natural Sources." By James S. Baldwin. New York: William H. Wileys and Co. "History of Chemical Theory." By Ad. Wurtz. Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan. "On the Application of the Conversion of Chlorates and Nitrates into Chlorides, and Chlorides into Nitrates, to the Determination of Several Equivalent Numbers." By Frederick Penny, Esq. "Proceedings of the American Association for the Advancement of Science." Cambridge: Joseph Lovering. "Lectures on Ventilation." By Lewis W. Leeds. "Observations on some of the Fundamental Principles and Existing Defects of National Education." By Neil Arnott, M.D., F.R.S., &c. London: Longmans, Green, and Co. 1869. "The Elasticity, Extensibility, and Tensile Strength of Iron and Steel." By Kunt Styffe. Translated from the Swedish by Christer P. Sandberg; with a Preface by John Percy, M.D., F.R.S. With 9 lithographic plates. London: John Murray. "Chemical Labels according to the latest system of Nomenclature." Compiled by H. Matthews, F.C.S., and C. W. Quin. London: H. K. Lewis. "Pocket Guide to the British Pharmacopoeia." "The Hospital Pharmacopoeias of London." By Peter Squire, F.R.S., &c. Second Edition. London: John Churchill and Sons. "Lessons in Elementary Chemistry, Inorganic and Organic." By Henry E. Roscoe, B.A., F.R.S. New Edition. London: Macmillan & Co.

AMERICAN SUPPLEMENT.

New York, June, 1869.

Supernaturalism and Science.

THE revival of learning by no means dispelled all the superstition of the dark ages. The supernaturalism of the present day is a very refined article, but there is such abundance of it that we meet it at every turn, and sometimes wonder if it really be not on the increase. At any rate, recent events urgently call attention to its luxurious existence, and suggest that men of science who have the welfare of society at heart ought to be alarmed. The newspapers of the day give accounts of witch-burning in Mexico, and of religious persecutions, and even wars, in various parts of the world; it is said that the believers in spiritualism are to be reckoned by millions; hundreds of thousands of a childish toy called a planchette have been sold to purchasers, who had been persuaded that it was endowed with supernatural qualities, and enough has been printed about the silly thing to constitute a library; supernaturalism has been offered and accepted as a suitable defence against a criminal charge in a court of justice, and as the prosecution failed to show by what specific natural means the act was committed, the prisoner was discharged,—and this, the present year, and in the enlightened city of New York. Persons calling themselves astrologers, clairvoyants, spirit mediums, &c., abound in every city and village, and get their living by the practice of their shallow arts; witnesses to the supernatural are found everywhere and in every rank of society. In short, among a considerable part of mankind the supernatural requires less testimony than the reality; in the name of supernaturalism, crime becomes innocent, and ridiculous folly appears solemn wisdom.

Now, against this dangerous epidemic of credulity there is nothing so effective as a course of treatment according to the scientific method. Where the disease has not reached its last stage, when the ability to reason and decide is wholly gone, a few applications of fundamental principles will bring about a convalescence. Science—we mean here especially mechanical philosophy and chemistry—is the epitome of the experience, observation, and reasoning of the most capable men of all times; it is our most positive knowledge. The laws of motion, the conservation of matter and of force, and a few axioms of mathematics and physics—these are the unquestioned universal truths; and using them as tests, we confidently reject whatever is inconsistent with them. Supernaturalism, on the other hand, is inconsistent with itself, and has no plausibility; and the testimony in its favor is the equivocal and conflicting statements of unskilled and incompetent witnesses. Supernaturalism invariably hides its face from the light of science.

We think that men of science do a wrong to society by ignoring the popular supernaturalism, or by treating it only with ridicule and contempt. They ought to know and feel that the cure or abatement of the evil is in their hands, and it should be a conscientious duty with them to apply it. And there are other considerations besides the immediate good to others that may fairly invite their attention to supernaturalism. The ingenuity and dexterity displayed by the miracle-workers are sometimes fit objects for amusement, admiration, or study. A curiosity as to the precise devices, and the principles of mechanics, &c., concerned in the

performances of skilled rappers, tipplers, writers, &c., should be encouraged and gratified. The psychology and physiology of supernaturalism are especially a promising field of research; the general belief in supernaturalism is almost a miracle in itself, and the philosophy of it has not yet been fully explored. Faraday set a good example in these regards to the scientific world, and if it had been well followed there would have been no occasion to print now such an article as this.

To our presentation of the subject there are a few who would raise the cavil that supernaturalism is not so opposed to science that it might not in some form be proved true. To such it is amply sufficient to say that we by no means deny the possibility of the truth of all supernaturalism; yet as the demonstration of its truth would require at least as much testimony as scientific truth, a supposed case is really of no practical account, and need not appear in the argument. What ghost of a shadow of a chance is there of the reality in any of the rubbish of the current supernaturalism? The probability, in our day, of any truth in supernaturalism is as small as the little end of nothing.

Is it necessary for us to say that men of science are not confined to the schools and to the professions, and that there are other sources of the science in this case needed than the text-books? Knowledge, without the judgment to use it, is of little avail. Hard common sense is sufficient for most emergencies, but when fortified with the accurate data of science, no error can stand in its way.

Finally, does not this discussion plainly suggest that the sciences and scientific methods are too much neglected in our educational systems? Let children be taught that supernaturalism is a delusion, and it would soon disappear from the world.

The Aurora Borealis.

IN *Harper's Magazine* for June is a very interesting article by Prof. Elias Loomis on the Aurora. It is profusely illustrated by appropriate engravings, and it occupies 20 pages of the Magazine. The following extract is from the part which treats of the theory of the Aurora, and is a good example of the logical method which appears through the whole article:—

At the height of 50 miles the atmosphere is well-nigh inappreciable in its effect upon twilight. The phenomena of lunar eclipses indicate an appreciable atmosphere at the height of 66 miles. The phenomena of shooting-stars indicate an atmosphere at the height of 200 or 300 miles, while the aurora indicates that the atmosphere does not entirely cease at the height of 500 miles. Auroral exhibitions take place, therefore, in an atmosphere of extreme rarity; so rare indeed that if, in experiments with an air-pump, we could exhaust the air as completely, we should say that we had obtained a perfect vacuum.

The auroral light is electric light. Our first reason for believing in this identity is derived from the appearance of the auroral light. The colors of the aurora are the same as those of ordinary electricity passed through rarefied air. When a spark is drawn from an ordinary electrical machine in air of the usual density, the light is intense and nearly white. If the electricity be passed through a glass vessel in which the air has been partially rarefied, the light is more diffuse, and inclines to a delicate rosy hue. If the air be still further rarefied, the light becomes very diffuse, and its color becomes a deep rose or purple. The same vari-

ety of colors is observed during auroral exhibitions. The transition from a white or pale straw-color to a rosy hue, and finally to a deep red, probably depends upon the height above the earth, and upon the amount of condensed vapor present in the air.

The emerald-green light which is seen in some auroras is ascribed to the projection of the yellow light of the aurora upon the blue sky, since green may be formed by a combination of yellow and blue light. A similar effect is often produced in the evening twilight by a combination of the yellow light of the sun with the blue of the celestial vault.

The light of electricity possesses certain properties which distinguish it from solar light. There are certain substances which, in ordinary solar light, appear almost entirely transparent, like pure water, but which, when illuminated by an electric spark in a dark room, present a very peculiar appearance, as if they were self-luminous. This appearance is termed fluorescence. When such substances are illuminated by auroral light, they exhibit the same peculiarity as when illuminated by the spark of an ordinary electrical machine.

These considerations must be admitted to create a strong probability that auroral light is identical with electric light. This probability becomes a certainty when we study the effect of an aurora upon the telegraph wires. The electric telegraph is worked by a current of electricity generated by a voltaic battery, and flowing along the conducting wire which unites the distant stations. This current, flowing round an electro-magnet, renders it temporarily magnetic, so that its armature is attracted, and a mark is made upon a roll of paper. During a thunder-storm the electricity of the atmosphere affects the conducting wire in a similar manner, and a great auroral display produces a like effect. During the auroras of August and September, 1859, there were remarked all those classes of effects which are considered as characteristic of electricity. We will enumerate the most remarkable of these effects:

(1.) In passing from one conductor to another, electricity exhibits a *spark* of light. This light is not like that of a burning coal or a heated iron, but a bright spark, without appreciable duration, which is renewed whenever the electricity passes. During the auroras of 1859, at numerous stations both in America and Europe, similar sparks were drawn from the telegraph wires when no battery was attached.

(2.) In passing through poor conductors electricity develops *heat*. In like manner, during the auroras of 1859, both in America and Europe, paper, and even wood, were set on fire by the auroral influence alone.

(3.) When passed through the animal system, electricity communicates a well-known characteristic *shock*. This electric shock is unlike any effect which can be produced upon the nervous system by any other known method. During the auroras of 1859 several telegraph operators received similar shocks when they touched the telegraph wires.

(4.) A current of electricity decomposes compound substances, resolving them into their elements. Most of the objects with which we are familiar in daily life are compounds; that is, are formed by the union of two or more elementary substances. The current of an ordinary voltaic battery affords one of the most efficient means of resolving compound bodies into their elements. The aurora of 1859 was found to produce similar decompositions. One method of transmitting telegraph signals, which has been successfully practised, is known

by the name of the electro-chemical, in which a mark is made upon chemically prepared paper, this mark resulting from the decomposition of the substance with which the paper is impregnated. This substance is decomposed by the passage of an electric current, and the change of color of the paper is the visible proof of the decomposition. The aurora of 1859 produced the same marks upon chemical paper as are produced by an ordinary voltaic battery.

(5.) A current of electricity develops *magnetism* in soft iron. The auroras of 1859 developed magnetism in a similar manner, and they developed it in such abundance that it was more than sufficient for the ordinary business of telegraphing.

(6.) A current of electricity deflects a magnetic needle from its ordinary position of rest. In England the usual telegraph signal is made by a magnetic needle, surrounded by a coil of copper wire, so that the needle is deflected by an electric current flowing through the wire. Similar deflections were caused by the auroras of 1859, and these deflections were greater than those produced by the telegraph batteries.

These facts clearly demonstrate that the fluid developed by the aurora on telegraph wires is indeed electricity. This electricity may be supposed to be derived from the aurora, either by direct transfer from the air to the wires, or may be induced upon the wires by the action of the auroral fluid at a distance. If we adopt the former supposition, then the light is certainly electric light. If we adopt the latter supposition, then, since we know of but two agents, magnetism and electricity, capable of inducing electricity in a distant conductor, and since magnetism is not luminous, we seem compelled to admit that the auroral light is electric light.

Aluminum.

THE great hope of virtues which the world expected to find in this metal has not been realized. When aluminum was first brought to extensive notice by the enthusiasm of Deville, under the stimulus of the imperial praise, it seemed to promise usefulness in almost all the arts; the catalogue of its virtues was longer than that of any other substance. At the present day, however, we ask What it is good for? and we pause for a satisfactory reply. Within a few years aluminum bronze has been much praised as an imitation of gold for ornamental purposes; it was supposed that here at last was the grand consummation of utilities. But, alas! we are doomed to another disappointment; for aluminum bronze, at least so far as our experience goes, proves to be the poorest imitation of gold that was ever imagined. Indeed, it is not so good as common brass, while the brass known under the name of oroides is vastly better.

The Boiler Waters of the Pacific Railroad.

THERE are very few railroads which are so located that good, fresh water for making steam is accessible. In the course of the long stretch of the Pacific Railroad, all the varieties of water which are annoying to engineers have been met with, and there is little doubt that the experience with these waters will prove of great value to the world. The table herewith presented exhibits the saline composition of the water at nine successive locomotive stations on the Union Pacific Railroad, the stations being from ten to fifteen miles apart. The analyses were made at the editor's

laboratory, and are as complete as the small quantity of material used in the work would allow. It was impracticable to determine the contents of gases and organic matter. An examination under more favorable circumstances will shortly be made, and it is con-

fidently expected that in some of these waters a notable amount of the rare alkali metals may be found. The names at the top of the table designate the stations as represented on the railroad time-table.

	Rawlins.....	Separation.....	Washakie.....	Red Desert.....	Bitter Creek...	Black Butte...	Point of Rocks...	Rock Spring...	Green River...
Sulphate of Soda.....	28.49	107.73	167.79	106.61	45.70	38.64	57.30	431.13	13.37
Sulphate of Potassa.....	....	24.64	....	3.78	....	10.71	....	....	2.31
Sulphate of Lime.....	24.15	178.15	73.08	17.99	23.10	12.60	25.41	354.76	3.01
Sulphate of Magnesia.....	....	80.08	35.49	5.67	....	....	1.96	258.51	....
Chloride of Sodium.....	28.84	....	5.74	....	18.20	....	17.15	285.25	....
Chloride of Potassium.....	5.11	23.66	23.38	2.17	25.55	7.21	32.90	284.55	3.64
Carbonate of Lime.....	6.65	....	....	....	....	3.01	....	....	2.59
Carbonate of Magnesia.....	8.05	41.72	....	....	52.29	15.68	15.82	....	3.92
Silica.....	....	3.08	.63	....	....	....	6.30	1.05	....
Alumina and Oxide of Iron.....	....	....	.35	....	....	....	....	5.67	....
Residues, per gallon.....	101.29	459.06	306.46	136.22	164.85	87.85	156.87	1,620.92	28.84

The Aurora and the Telegraph.

On Thursday evening, April 15th, there was the most brilliant auroral display that has been seen in this hemisphere since 1859. It was attended with the phenomena which usually characterize these exhibitions. The telegraph was in all parts of the country affected to such an extent as to render them almost useless for two or three hours. Mr. Dolan, the night manager of the Western Union office, at 145 Broadway, reports that the strongest effects were shown on the wires running east and west. The atmospheric current was very strong, and affected the instruments very much like a large main battery on short circuits. The battery was taken off the wires between this city and Boston, and for a quarter of an hour business was exchanged on the auroral circuits. The auroral current was very heavy west of Buffalo, but was less marked south, and the printing instruments between New York and Washington worked well throughout the evening. The first interruption to the wires in this vicinity occurred on the Long Island wires, and immediately afterwards the effect was thrown on the wires running east. The reports from other offices are of similar character.—*The Telegrapher*.

Again on the afternoon of May 13th the aurora manifested itself in disturbing the telegraph, and business was seriously interfered with, and, as before, especially on the lines running east and west. The following statement is copied from the *Washington Republican*: "About twelve o'clock yesterday auroral currents became quite observable upon the telegraphic wires, and rapidly increased in force until they interfered materially with the working of the lines, and at times entirely stopped the transmission of despatches. The effect of these currents was felt upon the wires of the Western Union Company all over the country—especially between Philadelphia and Pittsburgh and between this city and Lynchburgh, Va.—both of these lines being worked with considerable facility upon the auroral currents alone, the galvanic batteries having been detached.

"Some of the wires between Washington and New York were also worked in the same way, and Mr. Marean, the chief operator of the day force, succeeded

in an interesting experiment, viz., the substitution of a return wire for the ordinary ground circuit, upon which the same phenomena were observable as when the ends of the wire were connected with the earth. The interruptions continued until between six and seven o'clock, when they entirely ceased, and during the night the wires worked as finely as ever.

"There are several questions which will suggest themselves to the savans in regard to these demonstrations, among others whether the mountains over which the two lines most affected pass had any influence in inducing an excessive auroral current to pass. The Philadelphia and Pittsburgh line was the first to discover that the auroral current could be used in transmitting messages, and has upon all occasions of its presence had more than an average of these favors."

The Pairing of the Elements.

THE table of paired elements which appeared in the April SUPPLEMENT, and the remarks we made about it in the May SUPPLEMENT, have attracted considerable attention among those who are interested in chemical philosophy. The prevailing opinion appears to be that the pairing, which at present may not be regarded as anything beyond a curious fact, may be found at last to be allied or dependent upon some as yet undefined law of matter.

Of the letters which we have received upon the subject, the following is the most important:

"Your remarks on atomic weights in the April Number of CHEMICAL NEWS have suggested to me the enclosed table. You perceive that I have put the different elements at heights representing their atomic weights, and those of one series in columns together. The regularity observable is certainly a very rude one. But considering that every different combination of molecular elasticities (as shown by spectral lines) must give a new set of chemical properties, and considering that only about sixty elementary substances, out of the myriads which there might probably be, are known to us, we ought to expect no more accurate a classification of them than could be made of the animal kingdom, if only sixty animals were known.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBER'S PRICES.

DRUGS AND CHEMICALS.

Acetone	per oz	to 85
Acid, Acetic, No. 8	per lb	to 18
sp. gr. 1.047 U.S.P.	per lb	to 28
Chemically Pure	per lb	to 55
Glacial	per lb	to 1 60
Benzole, German	per oz	to 85
Boric acid, pure	per lb	to 85
Citric	per lb	to 1 20
Fluoric, 1 lb bottles	per lb	to 2 20
Formic	per lb	to 8 50
Galle	per lb	to 8 25
Hydrophosphorous	per lb	to 4 25
Lactic	per lb	to 4 25
Muriatic, 15 degrees	per lb	to 5
chemical pure	per lb	to 88
Nitric, 88 degrees	per lb	to 15
chemical pure	per lb	to 88
Oxalic, patent	per lb	to 85
Phosphoric, glacial	per lb	to 8 00
Prussic	per oz	8 to 9
Sulphuric	per lb	4 to 5
chemical pure	per lb	to 50
Valerian	per oz	to 1 40
Tartaric, powdered	per lb	80 to 85
Aconite Leaves	per lb	to 28
Aconitula	per dr	to 5 00
Agaric Alba	per lb	to 80
Alcohol, 95 per ct.	per gal	to 2 50
Aloes, Cape, powdered	per lb	to 86
Socotrine, powdered	per lb	to 1 25
Alum, Roman	per lb	to 11
lump	per lb	to 4 1/2
Ambergris, gray	per oz	to 14 00
Ammonia Carbonate, bulk	per lb	to 24
in jars	per lb	to 25
Muriate	per lb	to 17
Ammonia Aqua, 20 degrees	per lb	to 12
26 degrees	per lb	to 22
Hypophosphite	per lb	to 4 25
Oxalate	per lb	to 2 25
Phosphate	per lb	to 2 00
Sulphate	per lb	to 10
Ammonium Valerian, Crystals	per oz	to 1 50
Ammonium Bromide	per lb	to 2 80
Hydrosulphuret	per lb	to 75
Iodide	per lb	to 8 50
Amygdalin	per oz	to 3 75
Antimony and Potass	per lb	to 1 10
Butter	per lb	to 80
Arnica Leaves	per lb	to 20
Arrow Root, Bermuda	per lb	to 45
St. Vincent	per lb	to 18
Arsenic, white powdered	per lb	8 to 10
red pulv.	per lb	to 25
red, lump	per lb	to 80
Arsenic Solution, Fowler's	per lb	to 17
Iodide	per oz	to 90
Sol., Donovan's	per lb	to 88
Asbestos	per lb	to 15
Asparagin	per oz	to 3 50
Atropia	per dr	to 8 50
Sulphate	per dr	to 3 00
Valerian	per dr	to 4 50
Balsam Fir	per gal	to 4 75
Copalva	per lb	to 1 10
Peruvian	per lb	to 6 00
Tolu, true	per lb	to 1 85
Barbadoes Tar	per lb	to 12 1/2
Bark, Elm	per lb	to 18
Bark, Calisaya, quill	per lb	to 1 50
Red, quill	per lb	to 1 85
Pitayo	per lb	to 80
Cascarilla	per lb	to 80
Mezereon	per lb	to 25
Sassafras	per lb	to 12
Baryta Muriate	per lb	to 30
Nitrate	per lb	to 40
Bay Rum	per gal	to 3 75
Bebeerin, pure	per oz	to 5 00
Sulphate	per oz	to 8 50
Belladonna Leaves	per lb	to 25
Bicarbonate Soda	per lb	to 7
Bichromate Potash	per lb	to 23
Bismuth Metallic	per lb	to 8 50
and Ammonia Citrate soluble	per oz	to 85
and Ammonia Citrate Solution	per lb	to 1 80
Oxychloride	per lb	to 7 00
Subcarbon	per lb	to 8 00
Sub-Nitrate	per lb	to 7 50
Tannate	per oz	to 1 50
Valerianate	per oz	to 2 40
Black Drops	per lb	to 5 00
Blue Mass	per lb	to 58
Bole, Armenia, true	per lb	to 10
Borax, refined	per lb	to 40
Brimstone, roll	per lb	5 1/2 to
Bromine	per lb	to 3 50
Brucia	per oz	to 3 75
Buchu Leaves, long	per lb	to 62
short	per lb	to 38

Burgundy Pitch, true	per lb	to 15
Cadmium, Bromide	per oz	to 55
Iodide	per oz	to 70
Metallic	per lb	to 4 60
Sulphate	per lb	to 8 00
Caffeine	per oz	to 9 00
Calcium Chloride	per lb	to 90
Iodide	per lb	to 8 50
Calisaya Bark, Milhau's Original Elixir of	per doz	to 11 00
" " " " " "	per gross	to 120 00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz	to 11 00
" " " " " "	per gross	to 120 00
Calomel, Hydrosulph.	per lb	to 1 00
Camphor, Refined	per lb	to 1 10
Cannella Alba	per lb	to 35
Cantharides, powdered	per lb	to 2 00
Carbolic Acid crystals	per oz	to 17
" " solution	per lb	60 to 83
" " " common	per lb	to 85
Carbon Bi-Sulphuret	per lb	to 88
Cascarilla Bark	per lb	to 28
Cassia Buds	per lb	to 1 20
Castor Oil	per gal	2 75 to 2 80
Caustic Soda	per lb	to 9
Centaury Minor	per lb	to 38
Cerium, Oxalate	per oz	to 1 60
Nitrate	per oz	to 1 75
Chalk, Precip., English	per lb	to 28
Cherry Laurel Water	per lb	to 58
Chlorate Potass, English	per lb	to 50
Chloride Lime	per lb	to 8
Chloroform	per lb	to 1 88
Cinnamon, Ceylon, true	per lb	to 1 75
Citrine Ointment	per lb	to 58
Civet	per oz	to 5 50
Cobalt	per lb	to 28
Cocculus Indicus	per lb	to 36
Cocoa Butter	per lb	1 00 to 1 05
Codeine	per dr	to 2 50
Cod Liver Oil	per gal	to 2 35
Cod Liver Oil, ("Shore Oil")	per gal	to 2 25
Cod Liver Oil, J. C. Baker & Co.'s	per doz	to 8 00
" " " " " "	per gross	to 90 00
" " " " " "	per gross	to 87 00
Cod Liver Oil, Hazard & Caswell's	per doz	to 7 50
" " " " " "	per gr	to 90 00
Cod Liver Oil, Milhau's Golden	per doz	to 7 00
Milhau's Etherized	per gross	to 78 00
Cod Liver Oil, Milhau's, with the Hypo-	per doz	to 7 50
phosphite of Lime	per gross	to 84 00
Collodion	per lb	to 1 70
Cantharidal	per doz	to 4 50
Colo cynth, powdered	per lb	to 75
Confectio Rosa	per lb	to 48
Senna	per lb	to 48
Conium Leaves	per lb	to 25
Conium	per oz	to 7 50
Copper Ammoniated	per lb	to 1 20
Black Oxide	per lb	to 2 20
Carbonate	per lb	to 2 20
Sulphur, pure	per lb	to 88
Copperas	per lb	to 4
Corrosive Sublimate	per lb	to 1 00
Cream Tartar, powdered, pure	per lb	to 52
Cubebs	per lb	to 38
Cubeb	per dr	to 25
Cuttlefish Bone	per lb	28 to 30
Digitalis Herb.	per lb	to 18
Digitaline	per dr	to 2 65
Dover's Powder	per lb	to 3 10
Dragon's Blood, mass	per lb	to 1 00
reeds	per lb	to 1 10
Dulcamara Stems	per lb	to 18
Emetine	per oz	to 8 65
Emery Corn	per lb	to 11
Flour	per lb	to 8
Epsom Salt	per lb	to 8
Ergot, new	per lb	to 1 30 1/2
Ergotine	per oz	to 1 15
Ergotine	per lb	to 85
Ether, Acetic	per lb	to 4 10
Butyric, concentrated	per lb	to 1 60
Butyric	per lb	to 70
Chloric	per lb	to 85
concentrated	per lb	to 4 00
Formic	per lb	to 70
Sulphuric	per lb	to 80
washed	per lb	to 1 65
concentrated	per lb	to 8 65
Extr. Jockey Club, Chills	per lb	to 3 75
Extr. Esa. Bouquet, Chills	per lb	to 1 25
Extr. Banana, superior	per lb	to 1 25
Extr. Orange, superior	per lb	to 1 25
Flour Spar	per lb	to 16
Flowers, Althea	per lb	to 42
Arnica	per lb	to 24
Borage	per lb	to 95
Chamomile, German	per lb	to 35
Chamomile, Roman, 1867	per lb	to 29
Lavender	per lb	to 9
Malva, large	per lb	to 40
small	per lb	to 45

Flowers, Rosemary.....	per lb	to 70	Lactnarium.....	per oz	to 75
Tillao.....	per lb	to 70	Lead Acetate, pure.....	per lb	to 90
Violet.....	per lb	to 68	Licorice Paste, solid.....	per lb	to 40
Fusel Oil, purified.....	per lb	to 2 25	Sicily.....	per lb	to 80
Ferro-Phosphorated Elixir of Calisaya.....	per doz	to 12 00	Calabria.....	per lb	to 43
Bark, Hazard & Caswell's.....	per grs	to 144 00	Imitation.....	per lb	to 87
Gamboge.....	per lb	to 1 80	Barracco.....	per lb	to 44
Gelatine French Pink.....	per lb	to 1 45	P. S.....	per lb	to 45
Gelatine, White French.....	per lb	to 1 00	Lime, Carbonate, Precipitate.....	per lb	to 22
Cox's.....	per doz	to 2 50	Hypophosphite.....	per lb	to 3 75
Ginger, Jamaica, bleached.....	per lb	to 80	Iodide.....	per lb	to 8 00
Ginseng.....	per lb	to 85	Phosphate, Precipitate.....	per lb	to 40
Glauber Salts.....	per lb	8 to 4	Sulphite.....	per lb	to 31
Glycerine, common.....	per lb	to 85	Lime Juice.....	per gal	to 80
concentrated.....	per lb	to 50	Lint, Taylor's.....	per lb	to 1 80
"Bowers".....	per lb	to 50	Laps Calaminaris.....	per lb	to 8
"Price's".....	per lb	to 1 15	Laurel Berries.....	per lb	to 12
Glycerol Hypophosphite.....	per lb	to 1 75	Leaves.....	per lb	to 12
Grains D'Ambrette.....	per lb	to 82	Liquid Styra.....	per lb	to 60
Paradise.....	per lb	to 82	Long Pepper.....	per lb	to 90
Gum Acrolides.....	per lb	to 24	Lunar Caustic, pure.....	per oz	to 1 80
Amber.....	per lb	to 50	67 per cent., N. S.....	per oz	to 90
Ammoniac.....	per lb	to 60	Lycopodium.....	per lb	to 70
Arabic, Turkey, sorts.....	per lb	to 55	Magnesia Carbonate.....	per lb	to 45
1st picked, Trieste.....	per lb	to 95	Calcined.....	per lb	95 to 1 20
2d ".....	per lb	to 75	ponderous.....	per lb	to 1 80
3d ".....	per lb	55 to 60	Citrate.....	per lb	to 1 75
Barbary.....	per lb	to 40	Sulphite.....	per lb	to 1 20
Assafoetida.....	per lb	to 55	Manganese, powdered.....	per lb	to 8
Benzoin, common.....	per lb	to 90	Saxony.....	per lb	to 12
prime.....	per lb	to 1 00	Manna, small flake, '88.....	per lb	to 1 75
white marbled.....	per lb	to 1 10	large flake, '67.....	per lb	to 2 50
Copal, Accra.....	per lb	to 80	sorts, new.....	per lb	to 1 40
Benguela.....	per lb	to 45	Matico Leaves, true.....	per lb	to 50
Kowrie.....	per lb	to 60	Mercury.....	per lb	to 90
Damar, Batavia.....	per lb	to 55	cum Creta.....	per lb	to 56
Singapore.....	per lb	to 55	Magnesia.....	per lb	to 1 22
Elemi, Aromatic.....	per lb	to 55	Cyanuret.....	per lb	to 5 80
Euphorbium.....	per lb	to 25	Sulphuret.....	per lb	to 80
Galbanum.....	per lb	to 1 00	Mercurial Ointment (1/4 M).....	per lb	to 67
strained.....	per lb	to 1 25	(1/2 M).....	per lb	to 55
Gedda.....	per lb	to 80	Morphia Sulphate.....	per oz	to 11 00
Gualacum.....	per lb	50 to 60	Acetate.....	per oz	to 11 00
strained.....	per lb	to 60	Muriate.....	per oz	to 11 00
Kino.....	per lb	to 80	Valerianate.....	per oz	to 13 00
Mastic.....	per lb	to 4 25	Musk, true.....	per oz	to 16 00
Myrrh, Turkey, powdered.....	per lb	to 75	in grain true.....	per oz	to 32 00
Olibanum.....	per lb	to 80	Nux Vomica.....	per lb	to 14
tears.....	per lb	to 40	Oil, Amber, Crude.....	per lb	to 60
Sandarac.....	per lb	to 65	Almonds (Expressed) Allen's.....	per lb	to 90
Shellac, Campbell's D. C.....	per lb	to 60	Essential, Allen's.....	per lb	to 24 00
Garnet.....	per lb	to 55	Anise.....	per lb	to 4 25
No. 2.....	per lb	to 48	Bergamot.....	per lb	6 00 to 7 00
Native.....	per lb	to 48	FF, new crop.....	per lb	to 6 50
Senegal.....	per lb	to 50	Bergamot, Donner's.....	per lb	to 7 00
Tragacanth, common.....	per lb	to 50	Bergamot, —Sanderson's.....	per lb	to 7 00
flake.....	per lb	1 80 to 1 50	Cade.....	per lb	to 1 00
flaky sorts.....	per lb	to 60	Cajeput.....	per lb	to 2 00
Harlem Oil, Dutch.....	per doz	to 50	Camphor.....	per lb	to 1 75
Hoffman's Anodyne.....	per lb	to 48	Caraway.....	per lb	to 2 75
Hydriodate Potash, Atkinson's.....	per lb	to 5 60	Seed.....	per lb	to 5 50
Conrad's.....	per lb	5 20 to 5 40	Cassia.....	per lb	to 4 00
Hyoscyami Leaves.....	per lb	to 26	Cinnamon, true.....	per oz	to 1 50
Hypophosphite Ammon.....	per lb	to 3 75	Citronella, prime.....	per lb	to 2 65
Iron.....	per lb	to 8 50	Winter's.....	per lb	to 3 00
Lime.....	per lb	to 3 75	Copalva.....	per lb	to 3 00
Manganese.....	per lb	to 14 00	Croton.....	per lb	to 3 50
Potash.....	per lb	to 3 75	Cubebs.....	per lb	to 4 00
Soda.....	per lb	to 3 75	Cumin.....	per lb	to 10 00
Iceland Moss.....	per lb	10 to 12	Fennel.....	per lb	to 3 00
Indian Hemp, true.....	per lb	to 1 60	Geranium.....	per lb	12 00 to 22 00
Insect Powder, true.....	per lb	to 1 10	Chiris.....	per lb	to 18 00
Iodine, Resublimed.....	per lb	to 6 75	Prepared.....	per lb	to 25 00
Crude, in bulk.....	per lb	to 6 50	Turkish.....	per lb	14 00 to 18 00
Irish Moss.....	per lb	to 10	Jessamine.....	per lb	to 3 50
Iron, Alum.....	per lb	to 1 60	Juniper.....	per lb	to 1 20
by Hydrogen.....	per lb	to 2 80	Berries, true.....	per lb	to 3 50
Carb. Proto.....	per lb	to 45	Lavender, Garden, forte.....	per lb	to 1 65
Precip.....	per lb	to 25	fine.....	per lb	to 1 85
Citrate and Ammonia.....	per lb	to 1 45	Flowers, Chiris, No. 1.....	per lb	to 3 75
Magnesia.....	per lb	to 1 35	Lavender Spike.....	per lb	to 1 00
Quinine.....	per lb	to 10 00	Laurel, Expressed.....	per lb	to 90
strychnine.....	per lb	10 00 to 12 50	Lemon, Donner's.....	per lb	to 4 25
Hypophosphite.....	per lb	8 40 to 8 50	Lemon, —G. R. & Co's.....	per lb	to 4 75
Iodide.....	per lb	to 8 25	—Sanderson's (new).....	per lb	to 4 75
Syrup.....	per lb	to 80	Lemongrass, —Winter's.....	per lb	to 7 00
Lactate.....	per lb	to 3 25	Mace, Expressed.....	per lb	to 2 50
Phosphate, Precipitate.....	per lb	to 67	Marjoram.....	per lb	to 1 75
Pyrophosphate.....	per lb	to 1 25	Myrrbane.....	per lb	to 2 00
Syrup.....	per lb	to 65	Neroli Bigarade.....	per oz	to 5 00
Sesquichloride.....	per lb	to 1 45	Chiris.....	per oz	to 4 75
Sol.....	per lb	to 60	Pettit Grain.....	per lb	to 25 00
Sesquinitrate.....	per lb	to 44	Olive, pure.....	per gal	to 1 80
Subsulphate.....	per lb	to 1 70	Marselles, quarts.....	per box	to 6 00
Sulphate, pure.....	per lb	to 9	pints.....	per box	to 7 25
Exsiccated.....	per lb	to 17	Orange.....	per lb	to 4 35
Sulphuret.....	per lb	to 31 1/2	Origanum.....	per lb	75 to 1 40
Superphosphate Syrup.....	per lb	to 65	Patchouly.....	per oz	to 4 25
Tannate.....	per lb	to 6 60	Pennyroyal.....	per lb	3 75 to 4 00
India Ink.....	per lb	to 1 75	Peppermint, pure.....	per lb	6 50 to 7 00
Isinglass, American.....	per lb	to 1 85	Rhodum.....	per lb	to 10 00
Kassian, true.....	per lb	to 6 50	Rose, Kissauliek.....	per oz	to 10 00
Juniper Berries.....	per lb	to 6	Rosmary, French.....	per lb	to 1 75
Juniper Tar Soap, Hazard & Caswell's.....	per doz	to 3 75	Triste.....	per lb	to 1 15
Kreosote, white.....	per lb	to 1 10	Chiris.....	per lb	to 2 25

Oil, Sabine, pure.....	per lb	to 1 80	Scammony, virg., true.....	per lb	to 20 00
Sassafras, cans.....	per lb	to 1 10	Seeds, Anise.....	per lb	to 25
Sassafras, Salad, fine.....	per lb	to 2 50	star.....	per lb	to 55
Spearmin, Hotchkiss.....	per lb	to 6 50	Canary, Dutch.....	per bush	to 5 00
Spike.....	per lb	to 60	Smyrna.....	per bush	to 5 00
Succinum, crude.....	per lb	to 60	Cardamom, Malabar.....	per lb	to 4 60
refined.....	per lb	to 70	Carol.....	per lb	to 22
Tanzy,—"Eastman's".....	per lb	to 5 00	Celery.....	per lb	to 75
Thyme, white, pure.....	per lb	to 2 75	Clover.....	per lb	to 16
Valerian.....	per lb	to 18 00	Colicium.....	per lb	to 24
Wintergreen.....	per lb	to 5 00	Coriander.....	per lb	to 16
Wintergreen, Van Deusen Bros.....	per lb	to 5 00	Cummin.....	per lb	to 30
Wormwood.....	per lb	to 7 00	Fennel.....	per lb	to 20
Wormseed, Western.....	per lb	to 2 75	Fenugreek.....	per lb	to 12
Baltimore.....	per lb	to 8 50	Hemp.....	per bush	to 2 25
Black Pepper.....	per lb	to 1 25	Linseed, American clean.....	per tierce	to 2 50
Cognac.....	per oz	to 3 50	rough.....	per bush	to 2 50
Ergot.....	per oz	to 25	Bombay (gold).....	per bush	to 2 50
Opium.....	per lb	to 16 00	Calcutta (gold).....	per bush	to 2 50
Orange Buds or Apples.....	per lb	to 18	Mustard, brown.....	per lb	to 16
Curacao Ribs.....	per lb	to 28	white.....	per lb	to 16
Otto Rose, pure.....	per oz	to 10 00	Rape.....	per bush	to 5 25
Peppers, Zanzibar.....	per lb	to 7 50	Timothy.....	per bush	to 5 00
Phosphorus.....	per lb	to 33	Worm.....	per lb	to 28
Amorphous.....	per lb	to 1 20	Sedlitz Mixture.....	per lb	to 45
Piperin.....	per oz	to 8 25	Senna, Tinnevely.....	per lb	to 28
Podophyllin.....	per oz	to 1 50	Alexandria.....	per lb	to 55
Poppy Heads.....	per lb	to 80	E. I.....	per lb	to 25
Potassa, Acetate.....	per lb	to 35	Smalts, Blue.....	per lb	to 22
Bicarbonate.....	per lb	to 20	Snuff, Lorillard's Maccaboy.....	per lb	to 78
Carbonate.....	per lb	to 65	Coarse Rappee.....	per lb	to 1 00
Caustic, common.....	per lb	to 95	Irish High Toast.....	per lb	to 85
white.....	per lb	to 1 15	Fresh Scotch.....	per lb	to 85
Citrate.....	per lb	to 75	Soap, Castile, Mottled.....	per lb	to 16
cum Calce.....	per lb	to 4 25	White.....	per lb	to 25
Hypophosphite.....	per lb	to 80	floating.....	per lb	to 25
Permanganate, ordinary.....	per lb	to 2 75	Low's Brown Windsor.....	per grs	to 15 50
Phosphate.....	per lb	to 44	Soda Acetate.....	per lb	to 80
Prussiate.....	per lb	to 16	Chlorate.....	per lb	to 2 15
Sulphate.....	per lb	to 1 05	Chloride, Liquor.....	per gal	to 45
Tartrate.....	per lb	to 8 75	Citrate.....	per lb	to 1 00
Potassium.....	per oz	to 1 65	Hydro-sulphate.....	per lb	to 1 05
Bromide.....	per lb	to 82	Hypophosphite.....	per lb	to 4 10
Cyanide, fus.....	per lb	to 1 50	Hyposulphite.....	per lb	to 10
gran.....	per lb	to 5 25	Nitrate, pure.....	per lb	to 22
Iodide.....	per lb	to 35	Phosphate.....	per lb	to 31
Sulphuret.....	per lb	to 85	Pyrophosphate.....	per lb	to 1 25
Quinine, Citrate, with Iron.....	per oz	to 2 00	Sulphite.....	per lb	to 32 1/2
Sulphate, American.....	per oz	to 2 55	Ash.....	per lb	to 4
French.....	per oz	to 7	Sodium.....	per lb	to 11 00
Quassia, rasped.....	per lb	6 1/2 to 7	Iodide.....	per lb	to 8 00
Red Chalk Fingers.....	per lb	to 1 15	Spirit Ammonia.....	per lb	to 48
Red Precipitate.....	per lb	to 28 00	Aromatic.....	per lb	to 40
Resin of J. Jap, pure.....	per lb	to 48	Lavender.....	per lb	to 50
Rochelle Salt.....	per lb	to 24	Nitro Dale.....	per lb	to 40
Roots, Aconite.....	per lb	to 18	Rosemary.....	per lb	to 50
Alkanet.....	per lb	to 22	Sponges, Bahama.....	per lb	to 90
Althea.....	per lb	to 35	Bathing, Formes.....	per lb	to 4 00
Angelica.....	per lb	to 60	Coarse Brown.....	per lb	to 60
Calamus.....	per lb	to 20	Fine, medium.....	per lb	6 00 to 7 00
Colchicum.....	per lb	to 24	Surgeon's.....	per lb	4 00 to 7 00
Colombo.....	per lb	to 30	Zimoca.....	per lb	2 00 to 3 00
Culveris.....	per lb	to 20	Cap. Turkey.....	per lb	20 00 to 30 00
Dandelion.....	per lb	to 30	Trieste.....	per lb	4 50 to 18 00
Galangal.....	per lb	to 12	Fine Toilet, bleached.....	per lb	12 00 to 15 00
Gentian.....	per lb	to 15	Fine Trieste, small.....	per lb	4 00 to 4 50
Ginger, Race, African.....	per lb	to 20	Glove.....	per lb	1 75 to 2 00
Jamaica, Bleached.....	per lb	to 30	Grass.....	per lb	to 25
Golden Seal.....	per lb	to 30	Sheep's wool.....	per lb	1 60 to 1 70
Hellebore black.....	per lb	to 16	Sur Choix.....	per lb	to 5 50
white, powdered.....	per lb	to 85	Squills.....	per lb	to 12
Ipecacuanha.....	per lb	to 8 30	St. John's Bread.....	per lb	to 8
powdered.....	per lb	to 3 40	Strontia, Murate.....	per lb	to 30
Jalap.....	per lb	to 2 00	Nitrate.....	per lb	to 30
powdered.....	per lb	to 2 80	Oxalate.....	per lb	to 1 30
Lecorice.....	per lb	to 15	Strychnia, Acetate.....	per oz	to 3 75
Mandrake.....	per lb	to 15	Citrate.....	per oz	to 75
Morris, Florentine.....	per lb	to 17	Nitrate.....	per oz	to 3 75
Verona.....	per lb	to 15	Pure, crystallized.....	per oz	to 3 50
Pink.....	per lb	to 33	powdered.....	per oz	to 3 00
Rhatany.....	per lb	to 30	Sulphate.....	per oz	to 4 00
Rhubarb.....	per lb	2 50 to 4 00	Valerianate.....	per oz	to 5 50
Turkey.....	per lb	to 24 00	Styrax Calamita.....	per lb	to 55
Sarsaparilla, Honduras.....	per lb	to 60	Sugar of Lead.....	per lb	to 40
Mexican.....	per lb	to 28	Sugar of Milk.....	per lb	to 55
Turbeth.....	per lb	to 60	Sulphur Sublime.....	per lb	6 1/2 to 7
Valerian, English.....	per lb	to 65	Tamarinds.....	per lb	to 10
Dutch.....	per lb	to 40	Tannin.....	per lb	to 2 75
German.....	per lb	to 28	Taploca, East India, white.....	per lb	to 16
Vermont.....	per lb	to 40	Pearl.....	per lb	to 18
Snake, Virginia.....	per lb	to 44	Tartar Emetic, powdered.....	per lb	to 95
Seneca.....	per lb	to 55	crystallized.....	per lb	to 1 15
Rose Leaves.....	per lb	to 2 50	Tin Foil, thin.....	per lb	to 43
Rosemary Leaves.....	per lb	to 12	French, No. 15.....	per lb	to 80
Rubigo Ferri.....	per lb	to 10	Tobacco.....	per lb	to 40
Saffron, American, new.....	per lb	to 2 25	Tonqua Beans, Para.....	per lb	to 65
Spanish, true.....	per lb	to 17 00	Augustora.....	per lb	to 85
Sago, Pearl.....	per lb	to 12	Uva Ursi, American.....	per lb	to 12
Salicin.....	per oz	to 60	French.....	per lb	to 18
Sal Acetosella.....	per lb	to 55	Vanilla Beans, Bourbon.....	per lb	to 11 00
Ammoniac.....	per lb	to 16	Mexican.....	per lb	to 15 00
Soda, Newcastle.....	per lb	to 6	Venice Turpentine.....	per lb	to 83
Santonine.....	per oz	to 1 80	Veratrum.....	per oz	to 5 25
Sassafras Bark.....	per lb	to 10	Vitriol, Blue.....	per lb	15 to 16
			Green.....	per lb	2 1/2 to 4

Vitriol, White.....	per lb	to 9
Wax, White,—J. I. Elkins.....	per lb	to 75
Phillips' No. 2.....	per lb	to 72
Yellow.....	per lb	to 90
White Wax,—Leonhardt's.....	per lb	to 52
Oekmid.....	per lb	to 90
Sun-bleached.....	per lb	to 82
White Precipitate.....	per lb	to 80
White Pepper.....	per lb	to 1 50
Wine, Colchicum Seeds.....	per lb	to 58
Wood Naphtha.....	per lb	to 1 40
Wormwood Herb.....	per lb	to 95
Yellow Bark.....	per lb	to 25
Dock.....	per lb	to 80
Zaffre.....	per lb	to 25
Zinc, Acetate.....	per lb	to 1 15
Chloride.....	per lb	to 1 25
	per lb	to 1 50

DYES AND DYESTUFFS.

Aniline Blue.....	per lb	to 8 50
Red.....	per lb	to 8 50
Violet.....	per lb	to 8 50
Annatto.....	per lb	1 00 to 1 75
Cochineal, Honduras.....	per lb	to 1 40
Mexican.....	per lb	1 30 to 1 40
Cudbear.....	per lb	28 to 45
Cutch, Pegue.....	per lb	to 18
Gambler.....	per lb	to 8
Indigo, Bengal, fine.....	per lb	to 3 25
good.....	per lb	2 50 to 2 75
middling.....	per lb	2 00 to 2 10
Madras, fine.....	per lb	to 1 65
ordinary.....	per lb	to 1 25
Kurpah.....	per lb	to 2
Guatemala.....	per lb	2 00 to 2 10
Caracas.....	per lb	to 1 65
Lac Dye, good to fine.....	per lb	55 to 60
Logwood, Campeachy.....	per lb	to 2½
Honduras.....	per lb	to 2½
Jamaica.....	per lb	to 2½
Lazuna.....	per lb	to 2½
St. Domingo.....	per lb	to 2½
Extract.....	per lb	13 to 16½
" in bulk.....	per lb	to 18
Lima Wood (gold).....	per bbl	70 00 to 71 00
Madder, Dutch.....	per lb	22 to 24
French.....	per lb	23 to 25
Nutalls, Blue, Aleppo.....	per lb	to 40
Orehle.....	per lb	30 to 35
Persian Berries.....	per lb	50 to 55
Safflower.....	per lb	60 to 65
Sapanwood.....	per lb	12 to 15
Turneric.....	per lb	15 to 16
Ultramarine.....	per lb	23 to 45
Wood.....	per lb	15 to 16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials.....	50	percentage discount.
German Flint Bottles and vials.....	50	" "
Flint Bottles and vials.....	25	" "
Furniture Ware.....	10	" "
Perfumer's Ware.....	25	" "
Chemical Ware.....	net	" "
Syringes.....	10	" "
Homeopathic vials.....	10	" "

NAVAL STORES.

Pitch, City.....	per bbl	to 4 00
Rosin, Extra Pale.....	per 280 lbs	8 00 to
Pale.....	"	7 00 to
No. 1.....	"	5 00 to
No. 2.....	"	4 00 to
Strained.....	"	4 00 to
Common.....	"	to 3 75
Spirits, Turpentine (North Carolina).....	per gal	to 60
Turpentine, Soft.....	per 280 lbs	to 8 00

OILS.

Linseed Oil, American.....	per gal	to 1 13
English.....	per gal	to 1 13
Palm Oil.....	per lb	to 16
Paraffine Lubricating Oil.....	per gal	to 40
Sperm, Crude.....	per gal	to 2 10
Sperm, Winter, unbleached.....	per gal	to 2 20
Lard Oil Prime, City.....	per gal	to 1 75
Red Oil, City distilled.....	per gal	to 70
Red Oil, Saponified.....	per gal	to 73
Whale, Crude.....	per gal	to 1 35
Whale, Bleached, Winter.....	per gal	to 1 25

PAINTS (DRY).

Asphaltum, opt.....	per lb	to 7
Barytes, Foreign.....	per ton	to 45 00
Barytes, American.....	per lb	to 2
Black Lead.....	per lb	8 to 12
Black Ivory, drop, fair.....	per lb	10 to 18
good.....	per lb	13 to 20
best.....	per lb	24 to 28
Blue Celestial, good.....	per lb	to 14
Chinese.....	per lb	to 1 00
Prussian, fair to best.....	per lb	85 to 1 00
Ultramarine fair to best.....	per lb	23 to 45

Chalk, Lump.....	per lb	to 2½
China Clay.....	per lb	to 2½
Chalk.....	per bbl	to 4 50
Green Paris, fair to best.....	per lb	85 to 50
Green Chrome, fair to best.....	per lb	33 to 42
Lamp Black—Coach Painter's—L. Martin & Co.'s.....	per lb	23 to 25
Lamp Black, ordinary.....	per paper	8 to 12
Litharge, powdered, American & English.....	per lb	11 to 11½
Ochre, Yellow, French, dry.....	per lb	2½ to 4
Red Venetian.....	per lb	8½ to 5
Red Indian, fair to best.....	per lb	11 to 18
Red Lead, American.....	per lb	11 to 12
English.....	per lb	to 14
Rose Pink.....	per lb	to 20
Sienna, American.....	per lb	7 to 9
Italian, Bnt.....	per lb	13 to 22
Kaw.....	per lb	15 to 20
Umber, Crude, Turkey.....	per lb	5 to 7
burnt.....	per lb	8 to 9
Tieman's Calif. Vermilion.....	per lb	to 1 10
Pure Carmine.....	per lb	to 14 00
Soluble Blue.....	per lb	to 1 35
Vermilion, English, pale.....	per lb	to 1 15
deep.....	per lb	to 1 30
American.....	per lb	to 35
Chinese.....	per lb	to 1 20
Trieste.....	per lb	to 1 30
White, China.....	per lb	to 22
Cremnitz.....	per lb	to 30
Lead, pure.....	per lb	13 to 14
good.....	per lb	9 to 11½
Paris.....	per lb	8½ to 4
Zinc, American.....	per lb	10 to 12½
Zinc, French.....	per lb	14 to 16
Whiting.....	per lb	8½

PAINTS (IN OIL).

Black coach.....	per lb	28 to 30
Blue, Chinese.....	per lb	90 to 1 00
Prussian, fair to best.....	per lb	35 to 80
Brown, Van Dyke, fair to best.....	per lb	20 to 23
Dryer, Patent, American.....	per lb	12½ to 14
English.....	per lb	12½ to 15
Green, Chrome.....	per lb	13 to 27
Imperial.....	per lb	15 to 13
Paris.....	per lb	33 to 42
Verdigris.....	per lb	25 to 63
Putty, in bladders.....	per lb	5½ to 6
in bulk.....	per lb	to 5½
Red Venetian, fair to best.....	per lb	8 to 16
Sienna, burnt, fair to best.....	per lb	22 to 35
White Lead, English, B. B.....	per lb	to 16
American, pure.....	per lb	13½ to 14
good.....	per lb	11 to 12½
fair.....	per lb	9 to 10
White Zinc, American.....	per lb	10 to 13
French.....	per lb	15 to 15½
Yellow Ochre.....	per lb	9 to 10
Chrome, fair to best.....	per lb	16 to 32

SPICES.

Cassia, in mats.....	per lb	to 73
Cloves.....	per lb	to 43
Ginger, Race, African.....	per lb	to 19
Mace.....	per lb	to 1 60
Nutmegs, No. 1.....	per lb	to 1 45
Pepper.....	per lb	to 38
Pimento, Jamaica.....	per lb	to 34

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6 by 8 to 8 by 10.....	Per fifty feet	\$ 6 25 to 3 75
8 by 11 to 10 by 15.....	"	6 75 to 4 75
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 16 to 16 by 24.....	"	8 50 to 6 00
18 by 22 to 18 by 30.....	"	10 00 to 7 00
20 by 30 to 24 by 30.....	"	12 50 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 40.....	"	16 00 to 10 00
28 by 40 to 30 by 48.....	"	18 00 to 14 00
24 by 54 to 32 by 56.....	"	20 50 to 16 00
32 by 58 to 34 by 60.....	"	24 00 to 18 00
34 by 62 to 40 by 60.....	"	26 00 to 21 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6 by 8 to 8 by 10.....	Per fifty feet	\$ 6 25 to 4 75
8 by 11 to 10 by 15.....	"	6 75 to 5 00
11 by 14 to 12 by 18.....	"	7 50 to 5 50
13 by 16 to 16 by 24.....	"	8 50 to 6 00
18 by 22 to 18 by 30.....	"	20 00 to 7 00
20 by 30 to 24 by 30.....	"	12 00 to 8 00
24 by 31 to 24 by 36.....	"	14 00 to 9 00
25 by 36 to 26 by 40.....	"	16 00 to 10 00
28 by 40 to 30 by 48.....	"	18 00 to 14 00
24 by 54 to 32 by 56 (3 qts).....	"	20 50 to 16 00
32 by 58 to 34 by 60 (3 qts).....	"	24 00 to 18 00
34 by 62 to 40 by 60 (3 qts).....	"	26 00 to 21 00

Subject to a discount of 30 per cent. English sells at 10 per cent discount of the above rates.

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